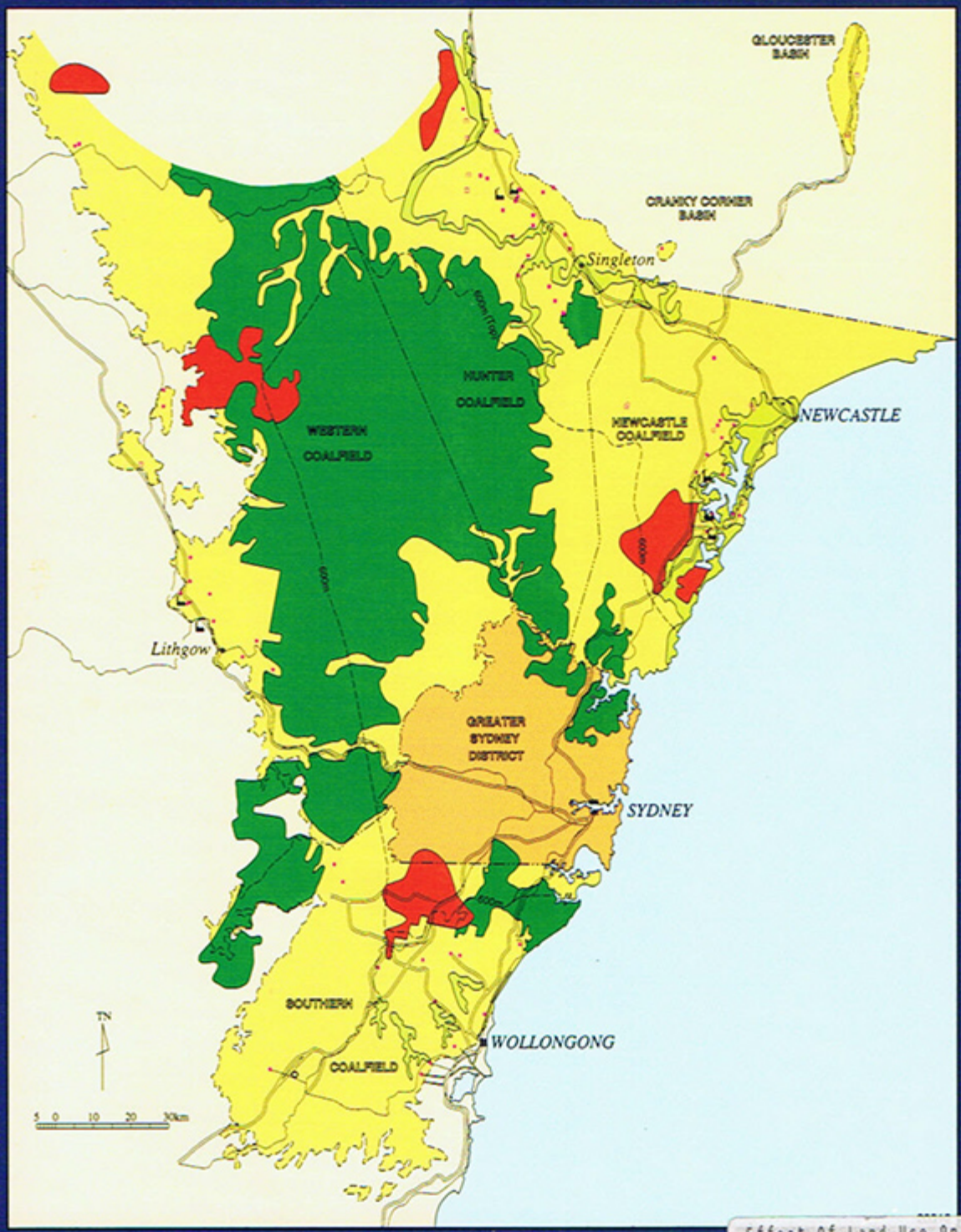
EFFECTS OF LAND USE ON COAL RESOURCES

REPORT PREPARED BY THE COAL RESOURCES DEVELOPMENT COMMITTEE



Effects of Land Use on Coal Resources - NSW 1994 - intro p 1.jpg

Foreword by the Hon Ian Causley, MP
New South Wales Minister
for Agriculture and Fisheries
and Minister for Mines

As Minister for Mines I am naturally fully aware of the importance of the coal industry to New South Wales - for its contribution to export earnings, as the supplier of an essential ingredient to the power and steel industries of the state, and for the employment which it generates.

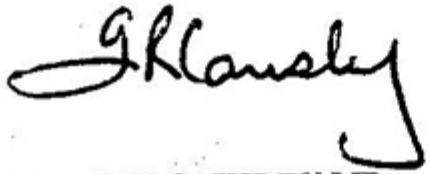
I also know that the coal industry can remain one of the key elements of this State's growth for many decades into the future. However, to do so the industry must be assured of access to the State's coal resources to meet the demands of export and domestic markets.

This report makes a valuable and timely contribution to the debate over the merits of the different forms of land use in the coal-bearing areas of New South Wales. It highlights the fact that we do not have infinite resources of high quality coal. Further, much of the coal is not available for mining or is under threat because of the effect of other land uses.

The recommendations made in this report need to be carefully considered by all those with an interest in the various land uses which might be proposed for areas containing significant coal resources.

I believe that it will be possible, with good will and full cooperation between the various parties, for the needs of the coal industry to be met, while at the same time arriving at satisfactory outcomes for proponents of other land uses.

I commend the Coal Resources Development Committee for this report and would particularly note that the diagrams included provide an excellent snapshot of the problems which face the coal industry as far as access to resources is concerned.



Hon. IAN CAUSLEY MP
MINISTER FOR AGRICULTURE AND FISHERIES
MINISTER FOR MINES

FEBRUARY 1994

REPORT PREPARED BY A WORKING PARTY OF THE COAL RESOURCE DEVELOPMENT COMMITTEE

Chairman:	**Brad Mullard** **NSW Department of Mineral Resources**
Secretary:	**Denis Casey** **NSW Department of Mineral Resources**
Members:	**John Hannan/Frank Topham** **NSW Coal Association**
	Gary Hartley **Mine Subsidence Board**
	Ken Sullivan **NSW Department of Planning**
	Carl Weber **Pacific Power**

FEBRUARY 1994

MAJOR FINDINGS

It is a commonly held view that New South Wales has sufficient coal resources to meet any longterm demand. This study undertaken by the Coal Resources Development Committee has found that New South Wales is likely to face a serious shortage of economically mineable coal in the future.

The coal industry makes a vital contribution to the standard of living of the people of New South Wales, by the revenue it has generated, the associated employment opportunities and its use in power generation and steel production. Forecasts predict that demand for New South Wales coal will increase by about 40 per cent, and then remain at about that level for at least a further ten years. To meet such demands, the coal industry will require access to economic high quality coal resources.

This study found that, although New South Wales has very large resources of coal, about half of the coal is already affected by other land uses, particularly National Parks and prime agricultural land. Furthermore, much of the remaining coal resource is of less than economic quality. Coal prices have been declining in real terms for at least 15 years. It is most unlikely that there will be a sustained real increase in price in the medium term. Therefore, coal resources which are clearly uneconomic at present are likely to remain so, even in the medium to long term.

The study found that if no new constraints were placed on mining of coal resources, production in each of the coalfields would follow these trends over the next 30 years:

Newcastle Coalfield down to half of current levels;
Hunter/Gunnedah Coalfields to almost double current levels;
Southern and Western Coalfields similar to present production.

There are at least ten new coal projects at advanced stages of planning or under construction. Most of these are in the Hunter Coalfield. These projects, in combination with expansions of existing mines, will provide the bulk of the forecast increase in production to about 2010.

However these projects are not sufficient to maintain production at the forecast levels beyond 2010. New mines will need to be developed on the high quality resources which are not currently held under title by mining companies (see enclosure 1). Importantly, most of these are under threat from some other form of land use or could attract strong community opposition if mining were proposed. Action is required to ensure that these high value coal resources will be available to meet the future needs of the coal industry, community and State.

The key issues in each coalfield are:-

Newcastle	*- urban development and the need to protect lake foreshores and flood-prone land from the effects of subsidence;*
Hunter	*- community concerns over the intensity of mine developments close to population centres like Muswellbrook; prime agricultural land overlying coal resources;*
Gunnedah	*- prime agricultural land;*
Southern	*- considerable coal resources occur under stored waters, while urban expansion in the Camden-Campbelltown area might compete with development of premium hard coking coal resources;*
Western	*- 75 per cent of the resources in this coalfield occur within existing National Parks, and an additional proposed National Park would seriously affect the life of existing collieries, as well as the exploitation of hitherto undeveloped resources.*

The CRDC concluded that the greatest problems in protecting areas for future coal development would come from declaration of new conservation areas and from the expanding surface utilization (land subdivision and urban development) of Eastern New South Wales. However, it also concluded that mining in areas where it has traditionally been excluded could take place without detriment to other land uses e.g. under railway lines or stored bodies of water.

KEY STRATEGIES

The CRDC recommended that a number of strategies be implemented to facilitate conflict resolution and allow the best use of the State's resources, including coal.

The key strategies identified were:-

- ***protection of strategically important coal resources;***
- ***proposals for Conservation Areas be required to include a Resource Impact Statement incorporating an assessment of all resources in the area;***
- ***development of a multiple land use strategy for Conservation Areas;***
- ***increased liaison and information exchange between the coal industry and the community;***
- ***preparation by the Department of Mineral Resources of a Strategic Coal Development Plan, which would include an assessment of the State's coal resources.***

CONTENTS

FIGURES

ENCLOSURE

1. INTRODUCTION

This report has been prepared by a working party appointed by the Coal Resources Development Committee (CRDC). The CRDC consists of representatives of New South Wales Government agencies, coal mining companies, local government and unions associated with coal mining.

One of the stated priorities for the CRDC is "the preparation of a strategy for long term planning of coal industry development, with particular reference to coal resources assessment and utilisation, transport, infrastructure and regional issues. Initially emphasis should be given to assessment of land use conflicts between coal developments and other land uses, with particular reference to avoiding unnecessary sterilisation of resources". The present study was undertaken to implement this priority of CRDC.

A major factor in the economic development of New South Wales has been the ready availability of coal for the major industrial and urban centres of Sydney, Newcastle and Wollongong. Historically, the presence of high quality coal near these areas has acted as a catalyst to urban and industrial growth.

However, the expansion of some of these centres, the growth of satellite centres and the demands of the population for infrastructure and recreational areas is now threatening long term access to the very coal resources that were a key ingredient in the development of the east coast of NSW. For example, urban development in the Newcastle Coalfield has severely constrained access to export quality thermal coal. Restrictions on extraction under more recent urban development around Lake Macquarie are seriously affecting the economics of coal mining in this district, to the extent that some mines have closed. In the Western Coalfield, the major part of the coal resource is now covered by National Parks, leaving only a few areas that are still unallocated and available for development.

Nevertheless, the easy access to low cost coal resources for such a long period has given rise to a commonly held belief that New South Wales contains vast coal resources sufficient to meet any foreseeable demand. Earlier studies by the NSW Coal Association in 1980 and the Department of Mineral Resources in 1986 showed that most of the State's coal resources were unable to be mined because of other land uses.

The CRDC therefore considered it appropriate to quantify the coal resource already affected or likely to be subject to competing land use in the foreseeable future. More importantly, it wished to identify and develop strategies that could reduce the impact of other land uses, particularly on economically

attractive coal resources. The CRDC appointed a working party in December 1991 to investigate the effects of different forms of land use on coal resources.

In its deliberations, the Working Party was conscious of the fact that coal is a low priced commodity. Therefore, profit margins are such that very small increases in the cost of producing coal impact adversely on the profitability of mining operations. Profitable mining requires that deposits have access to railheads, short transport distances to ports, suitable geological conditions and commercially acceptable coal quality.

1.1 Terms of Reference

The Terms of Reference were:-

1. To identify the types of land uses that affect the availability of coal resources including coal which has potential for methane production.

2. To assess the impacts of land uses on coal resources.

3. Assess the effects and implication of land uses on the availability of coal resources on a statewide and coalfield basis with particular emphasis on economically attractive deposits.

4. Broadly identify future pressures and developments that have the potential to affect the availability of coal resources.

5. Recommend strategies that could reduce conflicts between major land uses and the availability of coal resources having regard to compatibility of land uses, resource priorities, timing and other relevant critical issues.

1.2 Working Party Composition

Mr B Mullard, Chief Geologist - Coal and Petroleum, Department of Mineral Resources (DMR), was nominated Chairman. Mr D Casey, Executive Officer Coal DMR was appointed Secretary of the Working Party. Other members of the Working Party and their affiliations were as follows:-

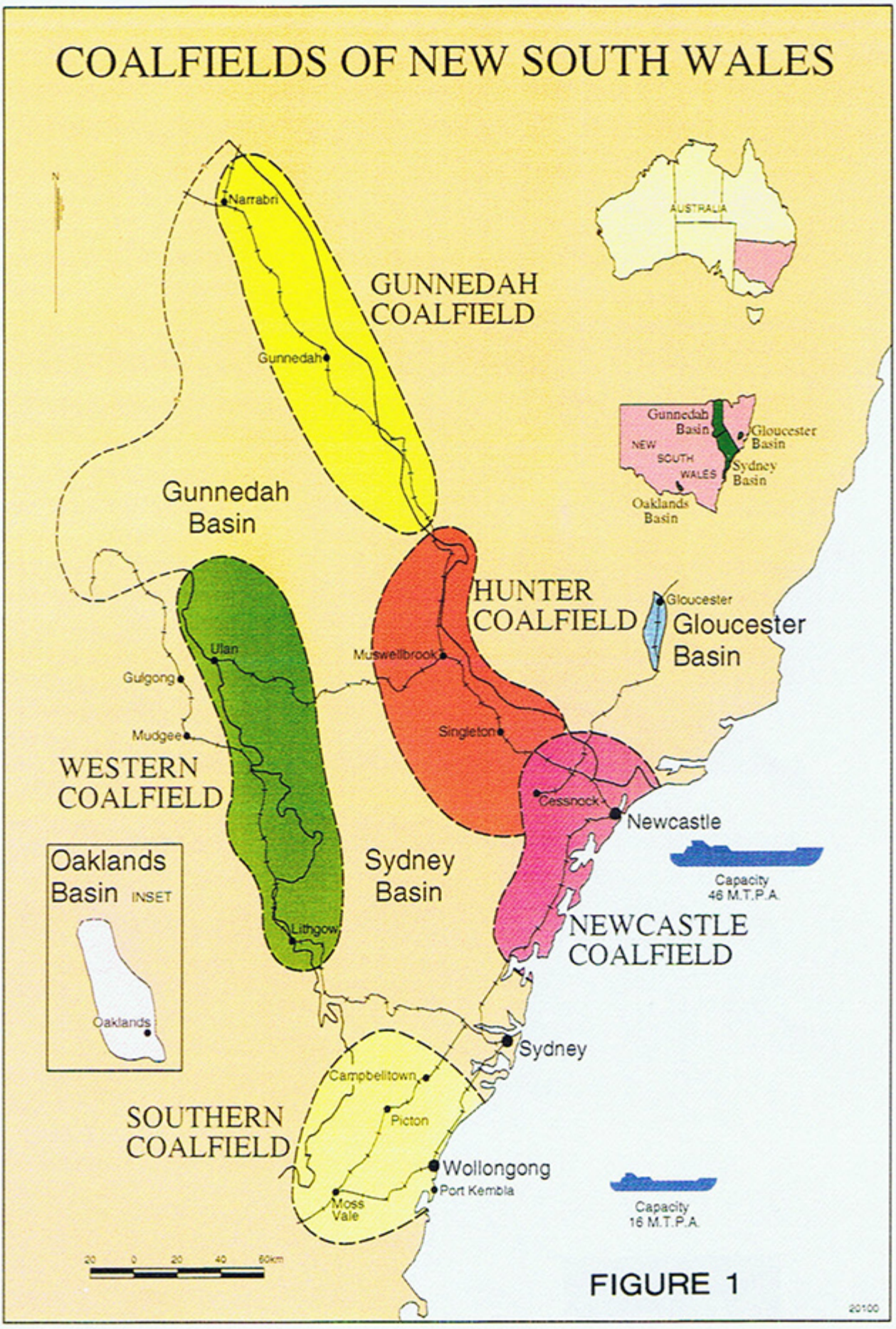
Department of Planning	- Mr K Sullivan
Mine Subsidence Board	- Mr G Hartley
NSW Coal Association	- Mr J Hannan/Mr F Topham
Pacific Power	- Mr C Weber

1.3 Methodology

After the Working Party agreed on the various categories of land use that might affect coal resources, the Coal and Petroleum Geology Branch of the Department of Mineral Resources estimated resources affected by these land uses. The Working Party then identified several future developments that might have an impact on coal resources and the quantities of coal resources which would be affected were also determined by the Coal and Petroleum Geology Branch.

Several areas with high potential for coal development were identified in each coalfield and the pressures of competing land uses on these were discussed. A series of maps was compiled, showing the relationship between coal resources and land uses for each coalfield. A more general map was also prepared, highlighting the most economically attractive prospects that are currently undeveloped and their relationship to areas with prohibitions or restrictions on mining.

Coal supply/demand scenarios were developed for three different times viz. 2000, 2010 and 2020. This helped give some idea of the directions that the industry might take in the next 30 years. Deposits that have good potential to be developed in the future are discussed, particularly in relation to possible land uses with the potential to limit or prevent mining occurring. Finally, the Working Party proposed strategies that it considered would minimise land use conflict.



Effects of Land Use on Coal Resources - NSW 1994 - p 04.jpg

2. BRIEF HISTORY OF COAL MINING IN NEW SOUTH WALES

2.1 Introduction

The history of many New South Wales cities and towns is intimately associated with coal mining from the earliest days of settlement in New South Wales. Coal was discovered south of Newcastle in 1791, three years after the first white settlement in New South Wales. In 1797, coal outcrops near Coalcliff were noted. Because of its greater accessibility, coal adjacent to the Hunter River at Newcastle was the first to be mined in New South Wales. Eventually, several coalfields were identified in eastern New South Wales (see figure 1).

The development and growth of the east coast cities were in many ways dependent on the proximity of coal for use as an energy source. However, as these urban areas have continued to grow, conflict has occurred between coal mining land requirements and urban development.

2.2 Northern Coalfield

In 1800 coal mining was started in the Newcastle area. Mining remained under Government control until 1831 when the Australian Agricultural Company commenced mining in the Newcastle town area. However, the government officials were not content to leave all matters in the hands of the company. Advice was sought from John Busby, a civil engineer, on the depth at which coal might be mined without endangering the buildings above, a matter that was to involve the company some 80 years later, when subsidence damaged the Anglican Cathedral.

Until about 1860, the mines were generally confined to an area now covered by the suburbs of Newcastle e.g. at Hamilton, Wallsend, Lambton and Hexham.

During this period the companies built cottages for their miners and gave land and subscriptions towards churches, schools, cemetery and hospital, which fostered a close identification of the local community with coal mining. By 1861 Newcastle was heavily dependent on the coal industry, with 900 miners and 5 000 associated workers. This pattern of close association of coal with the fortunes of Newcastle continued.

By the mid 1880s mine owners began to look for new thick seams, in which the coal could be reached with shallow pits and short drives, as in the early days of mining at Newcastle. Geologists identified large resources of shallow coal west of Newcastle, as well as in the Illawarra district.

By the beginning of the twentieth century, there was scarcely a part of the growing city of Newcastle that was not a series of caves. Very large quantities of coal had been left as pillars in these generally shallow workings for support. Probably only 25-40% of all the coal was ever removed.

In the early years of the twentieth century the colliery industry burst the bounds of the centralised Newcastle field and invaded the Greta area in a large way and, more gradually, the distant environs of the Newcastle field. With the opening of new mines many mining towns and villages were established in the Greta-Maitland district.

Significant production also commenced in the Cessnock district in the early 1900s with the development of numerous mines. Cessnock's population grew from 140 in 1904 to 20 000 by 1924, predominantly to service the coal industry.

A long period of industrial unrest, coupled with obsolete mining techniques and general unprofitability of the industry ultimately led to a shortage of coal after World War II. The industry made a dramatic resurgence in the 1950s with the introduction of large scale open cut mining. Some of these open cut mines were developed by the Joint Coal Board that had been established in 1947 to improve the productivity of the coal industry. There were 19 open cuts in 1952, many in the Northern Coalfield, but a major debit was the surface devastation that was left unrepaired for many years.

A substantial coal mining industry developed in the Lake Macquarie district after World War II to supply coal to the power stations that were being established in the Lake Macquarie area.

As the mines of the Cessnock area became uneconomic with increasing depth, the focus of the coal industry moved further up the Hunter Valley to the Singleton-Muswellbrook area. Coal had first been mined at Rixs Creek near Singleton in the 1860s but only a few mines operated in that area until the 1950s.

The early 1970s was a period of virtually uninterrupted growth for the coal industry, particularly in exports to Japan. Mines in the Singleton district participated in this growth. The oil shocks of the 1970s produced a flood of optimistic growth forecasts in the mid-70s that suggested a demand for coal in excess of anything the industry had previously contemplated.

Increased demand was reflected in coal prices so companies rushed to develop the very large, high quality open cut resources of the Singleton district because of the optimistic forecasts.

Residents of Singleton, Muswellbrook and other settlements in the Upper Hunter were concerned at the effect large-scale developments would have on their lifestyles.

Concerns of the residents centred on several factors:

- pressure on existing services and facilities because of the speed of population growth if most of the expanded workforce were to settle in the Upper Hunter
- friction caused by wages differential between mining personnel and town and rural workers
- demands for additional facilities and services by the incoming workers
- deterioration of air and water quality a general loss of amenity because of the large number of mines starting up e.g. increased number of trucks on the road.

In the event, the boom was not as extreme as forecast due to a world oversupply of both steaming and coking coal from 1983.

Planning procedures have evolved under the Environmental Planning and Assessment Act (1979) to deal with many of the issues that concerned Upper Hunter residents when the rapid expansion of mining was being predicted. The benefits that coal mining has brought to the Singleton area are generally recognised, although there are still situations where residents initially strongly oppose particular mining developments.

Great improvements in the quality of rehabilitation of open cut mines have also increased the acceptance of the coal mining industry.

The focus of mining developments is now moving further up the Valley into the Muswellbrook district. Stringent environmental safeguards and an extensive educational program will be required for the acceptance of these developments by the local community.

The Boggabri-Gunnedah area has been the location of only a few small mines to date, although two large projects are planned for later in the decade.

2.3 Southern Coalfield

Although coal was discovered at Coalcliff in 1797, mining lagged the Newcastle development because of the lack of a suitable port to provide easy access from the Illawarra to Sydney. It was 1857 before the first mine was opened at Mt Keira near Wollongong and by 1870, only three collieries were in operation.

Several factors influenced the development of a coal industry from this period - the introduction of steamships, railway construction, coke industry establishment and the construction of shipping facilities.

A feature of the coal industry in the Illawarra has been the longevity of many of the mines that have operated from the 1860s or 1870s virtually to the present day e.g. South Bulli, Metropolitan, Coalcliff and South Clifton.

A number of mining villages grew in response to the advent of coal mining e.g. Wonoona, Bellambi and Bulli. Coal mining was the chief occupation of workers in these villages where the miners were often housed in company cottages.

By the 1920s more than half the district's population lived in small mining settlements in the coastal foothills. Even in Wollongong which was south of the coal mining area, at least one-third of the workforce in 1921 was employed in coal mining.

The industry received some impetus from the opening of the Port Kembla Steelworks in 1928 by Australian Iron and Steel Ltd (AIS). The development of the steelworks with the associated influx of workers also reduced the direct significance of coal to the economy of the district.

Broken Hill Proprietary Co. Ltd (BHP) owns mines in the Southern Coalfield that supply its Port Kembla and other Steelworks. The district has also participated in the development of export markets since the 1960s, with several mines selling high quality coking coal to Japan and other countries.

Coal was first recorded in the Burragorang Valley district in 1806. Coal mining only commenced in the Burragorang Valley in the early 1930s, although the first mining efforts failed. However, from the late 1930s coal mines became viable and provided employment for many in the Camden district. At the time there were very limited employment opportunities in the rural sector but even so, there was still some resentment at the intrusion of coal mining into the settled rural environment.

The development of an export market to Japan provided a substantial boost to the coal industry in the 1960s, at which time miners moved to the district to take up employment in the expanding mines. The mining industry gradually became accepted in the district, although road transport of coal was then (and still is) a contentious issue with local residents.

2.4 Western Coalfield

The earliest record of coal was in 1822. Although landowners in the Lithgow area gathered coal for their domestic use, the isolation of this area from Sydney by the Blue Mountains prevented any commercial exploitation until 1868.

Gradually other mines opened in and around the town of Lithgow to supply the railway and heavy industry such as copper smelters, which were built in the mid 1870s.

Although Katoomba is now a dormitory suburb for Sydney as well as a major tourist centre, it started as a village for coal miners employed at local mines. Coal was discovered at Katoomba in the late 1860s and mining operations commenced in 1878. Mining ceased about 1900 because of the high cost of transportation, reopened in 1925 but closed in 1939 because of deteriorating coal quality and transportation difficulties.

It is interesting to note that one of the tourist attractions of the Blue Mountains, the Scenic Railway, originally was used to haul coal from the mine to the top of the cliff line. Even while the mine was operating, the railway used to carry bushwalkers for a fee to supplement the mine's revenue.

Coal was also discovered north of Lithgow but the mines in the vicinity of Lithgow were better placed to supply the railway and industrial markets.

Discoveries of coal were also made even further north of Lithgow, from Cullen Bullen to Kandos. A major impetus to coal mining in this area was the development of a cement industry that was made possible by the juxtaposition of coal and limestone in large quantities.

During the 1970s and early 1980s, mining expanded rapidly in the west. Two mines were developed at this time to meet export demand for steaming coal. The low export prices for coal in 1986-1987 forced the closure of a number of mines, although some of these have since reopened with new ownership and are operating at a smaller scale.

The continued need for mines to supply the western power stations will ensure that the close association of the Lithgow district with coal mining will continue.

2.5 Summary

Coal mining and early settlement in the Newcastle, Wollongong and Lithgow areas have been closely associated. The coal mining industry has been the reason for the establishment of many towns and villages in these areas. This historical association traditionally led to an empathy between the industry and the communities dependent on it, which resulted in acceptance of many of the features associated with coal mining.

In the past 20-30 years the spread of urban development has resulted in most of the population in the traditional coal mining areas not being as directly dependent on that industry. Some of these residents are not as tolerant of the industry. Nevertheless, coal mining still brings significant benefits to regions where it is active. In recent years the industry has expanded and developed mining techniques that have increased production rates and affected larger areas of land and other land uses. Simultaneously communities have come to expect higher environmental standards, that areas will be reserved for passive recreation and that a higher priority will be placed on preservation of areas with outstanding scenery or natural phenomena. This is reflected in protection of areas of environmental and heritage significance, including National Parks.

The outcome of these pressures currently is that the coal industry does not have automatic and unquestioned access to coal resources at the expense of other land uses.

Today the industry must justify its claims and show that mining can be carried on in an environmentally acceptable manner, with the minimum impact on other land uses.

3. THE NEW SOUTH WALES COAL INDUSTRY

3.1 Introduction

The major coal resources of New South Wales are located in the 500 km long, 150 km wide Sydney-Gunnedah Basin. It extends from south of Wollongong to north of Newcastle and north-westerly through Narrabri into Queensland (figure 1). Smaller resources are located in the Gloucester and Oaklands Basins.

A large variety of coal types, ranging from low-volatile, hard coking coals to high quality thermal coals occur in the Sydney-Gunnedah Basin. There are five major coalfields within the Basin: Hunter, Newcastle, Southern, Western and Gunnedah (figure 1).

By far the most important uses for coal are in steel production and power generation. In steel-making, coal is used as a source of carbon for the chemical reduction of iron ore to steel in the blast furnace. The coal must first be transformed from coal to coke; to be suitable for such use the coal must have particular properties of swelling in the coke ovens and of producing physically strong coke. Coal having these properties is refered to as "Coking coal" or "metallurgical coal". Coking coal attracts a higher price than coal used for other purposes.

In power generation, coal is used as a source of thermal energy. Before burning, the coal is dried and pulverised. It is then blasted into the boiler furnace in a stream of preheated air, where it ignites and fires the boiler. The high-pressure, superheated steam so produced is fed to steam turbines that in turn drive the electrical generators to produce electricity. Coal used in power generation is called thermal or steaming coal. Steaming coal is also used in cement manufacture and for industrial heating.

Saleable coal production in New South Wales for 1992-93 was 84.2 million tonnes, a record figure. Domestic consumption in the same period was 28.1 million tonnes, marginally more than the previous year. The bulk of this coal (20.9 Mt) was used in power stations to produce almost all of New South Wales' electricity requirements. The steel industry consumed 6.1 Mt and cement works 0.4 Mt.

During 1992-93 coal exports of 57.4 Mt represented 68% of saleable coal production. This was divided into steaming coal, 33.8 Mt and coking coal, 23.6 Mt. There has been a substantial growth in steaming coal exports in the last decade; forecasts are for this increase to continue but coking coal exports are likely to show little long term growth.

Japan is the main market for New South Wales coal, taking 56% of the State's total coking exports in 1992-93 and 53% of its total steaming coal exports for the same period. Other Asian countries like Korea and Taiwan are also significant consumers. Only 9% of New South Wales' coal exports go to Europe.

3.2 Newcastle Coalfield

In 1992-93 saleable coal production from the Newcastle district amounted to 16.9 Mt (20% of New South Wales production) from 17 mines, virtually all of them underground. Production peaked in 1986-87 at 18.2 Mt and is forecast to remain in the 17-18 Mtpa range through to the year 2000. The future level of production from this area is to a degree dependent on the fate of the Pacific Power mines. Newvale No.1 has already closed and Awaba's production has been scaled down following the loss of contracts to power stations and the absence of buyers for these mines. As well as domestic thermal markets, the Newcastle field supplies coking coal to the Newcastle Steelworks and coking and thermal export coal.

3.3 Hunter Coalfield

In 1992-93, the Hunter region produced 37.5 Mt of saleable coal, which amounted to 45% of New South Wales production. In recent years the Hunter has been the major growth area for New South Wales production with 16 mines (the majority open cut operations) currently in production and several more mines, both open cut and underground, in advanced planning stages. Saleable coal production is forecast to expand from the present 38 Mtpa to about 46 Mtpa by 2000.

Mines in the Hunter Coalfield supply thermal coal to Bayswater and Liddell power stations (10 Mt in 1992-93) with the remaining production comprising export thermal and metallurgical coal.

3.4 Gunnedah Coalfield

In 1992-93 the Gunnedah district produced 1.5 Mt from three small mines supplying mainly export markets. Two large open cut mines may open in the Gunnedah district by the year 2010 to supply export markets.

3.5 Southern Coalfield

During 1992-93 the Southern Coalfield produced 16.3 Mt of saleable coal, equivalent to 19% of the State's coal production. However, this district supplies almost 90% of the State's coking coal production and provides up to

80% of all coking coal blends for all the Australian steelworks. Production is forecast to remain constant to 2000 at around 16 Mt.

3.6 Western Coalfield

During 1992-93 production from the Western Coalfield amounted to 12.0 Mt of saleable coal (mostly thermal) or 14% of New South Wales production. By 2000 this production is forecast to increase to about 17 Mt. A large part of this growth is required to supply the Mount Piper Power Station which came on stream in 1993.

3.7 Mining Methods

Coal is mined by either surface or underground methods. Surface mining involves the removal of overburden to expose the coal for subsequent extraction. Often overburden must be fractured and loosened by explosives before its removal. Two of the most common methods of removing overburden are by dragline or truck and shovel. Once the coal has been exposed, it is generally loaded by power shovels or front end loaders into off-road trucks for haulage out of the pit.

Two methods of mining are used in underground mining - bord and pillar and longwall. Longwall mining has increased in recent years with substantially more coal being produced by longwall methods (32.6 Mt) compared to bord and pillar (12.3 Mt) in 1992-93.

In bord and pillar operations underground roadways (bords) are cut into the coal seam with pillars of coal being left to support the roof (figure 2). Continuous mining machines extract the coal. Depending upon the mine's design and cover depth, approximately 30-40% of the coal is mined as "first workings" (figure 2). Once the first workings are completed, the standing pillars and surrounding coal are systematically extracted, working back towards the main access roadways. This part of the operation is called "second workings" or pillar extraction. During pillar extraction, as much coal as possible is progressively removed, causing the roof to collapse to form the "goaf" area. Subsidence of the surface occurs shortly after extraction is completed. Up to 85% of the coal in a single seam can be removed by this type of extraction.

It is possible to limit the surface subsidence by leaving a proportion of the pillars in place to support the overlying strata. This is known as partial pillar extraction. If it is necessary to prevent subsidence completely, no second workings are carried out. As this sterilizes 60-70% of the coal reserves, it affects the economics of the operation and results in the permanent loss of

valuable coal reserves. The tonnage lost can be significant if a large area is affected. Nevertheless, such restrictions are required by the Department of Mineral Resources from time to time to protect surface features, either natural or manmade.

Bord and pillar operations have a low capital cost but are labour intensive and therefore have a high operating cost. Many such operations in New South Wales are currently economically marginal or even unprofitable.

Longwall mining is used in an increasing number of mines in New South Wales. With this method of mining, most of the coal is extracted by a series of large cuts as the mining machine traverses the face that may be up to 200 metres wide. A panel can be up to 2 km long (figure 3). As no coal is left to support the roof at the mining face, hydraulic roof supports must be used to hold up the roof near the mining face.

A major advantage of longwall mining is that it can achieve very high rates of output.

The effects of surface subsidence from longwall mining are essentially the same as those resulting from the second workings in bord and pillar operations. However, the subsidence effects are more uniform and therefore more able to be predicted. It is also possible to control the amount of subsidence from longwall mining by varying the width of the extracted panels and by separating adjacent panels by rows of pillars that are left in place.

Figures 4 and 5 illustrate the surface area affected by subsidence due to mining (known as the angle of draw).

3.8 Coal in Closed Collieries

The Department of Mineral Resources requires companies to extract the maximum tonnage of coal that is economically feasible to ensure the best use of the State's resources. It also critically examines proposals for mine closures to ensure that coal is not unnecessarily sterilised.

However, it must be recognised that it is impossible to extract all the coal resources within a colliery holding. Some coal will need to be left behind because

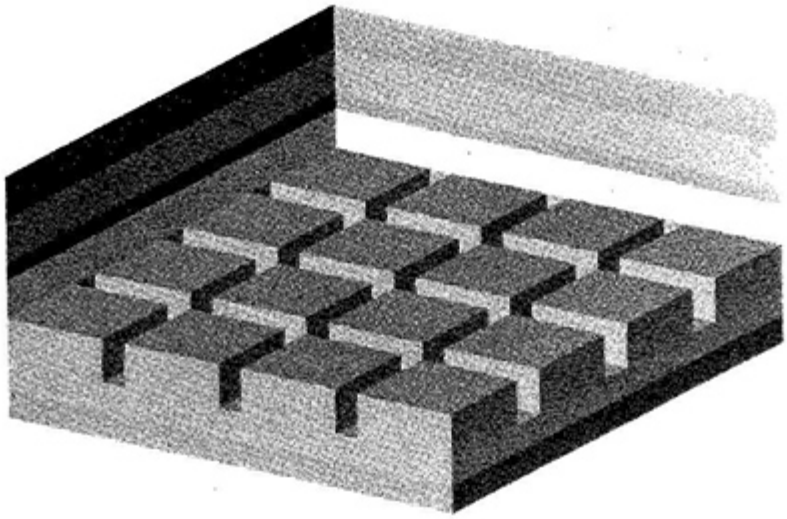
- coal quality deterioration can result in an unmarketable product.
- some coal will need to be left to support the roof to ensure a safe mining environment.
- the mining conditions can deteriorate so that it is no longer safe to continue to extract the coal.
- the need to protect surface features results in restricted extraction.
- mining costs can exceed the value of the coal mined.

Some coal resources do remain in closed collieries, particularly in older collieries. In many older mines, the technology did not exist to allow the safe extraction of a high proportion of coal pillars used to support the roof. In addition, many millions of tonnes were left behind in roadway floors, in roofs or in areas that were not mined for a variety of geological or engineering reasons.

Many of these old mine workings are now flooded; further mining would not be possible without dewatering and would, in any case, be unsafe. Moreover, even if they could be dewatered, many of these workings underlie urban areas e.g. around Newcastle. As a consequence further mining could not be carried out due to concerns about damage by subsidence.

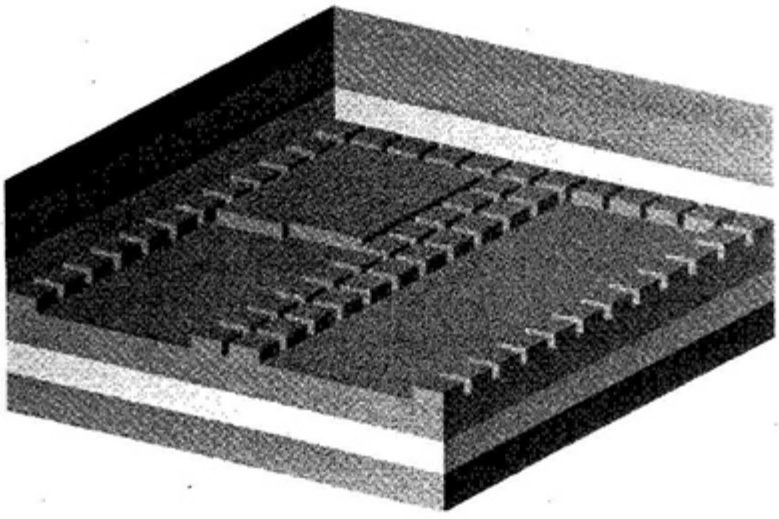
It would be beyond the scope of this report, and in many cases impracticable, to determine the quantity of coal remaining in the mined areas of closed collieries. If the unmined areas are accessible from adjacent collieries and not affected by other land use, such as urban development, they are considered as an available resource in this report.

FIGURE 2



In bord and pillar operations underground roadways (bords) are cut into the coal seam with pillars of coal being left to support the roof.

FIGURE 3



In longwall mining the coal is extracted by a series of large cuts as the machine traverses the face that may be up to 200 metres wide. A panel can be 2 - 3 km long .

FIGURE 4

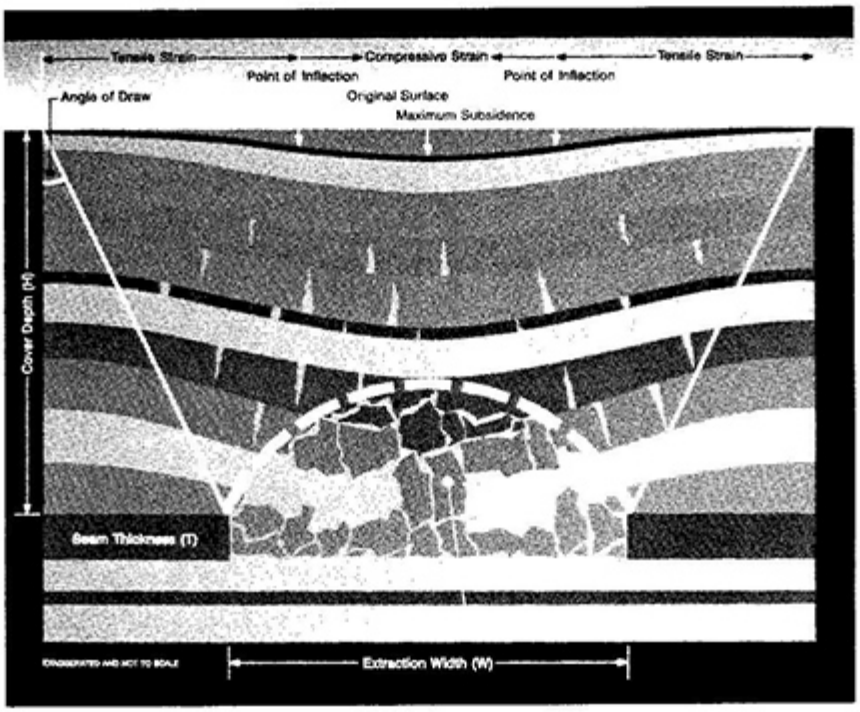
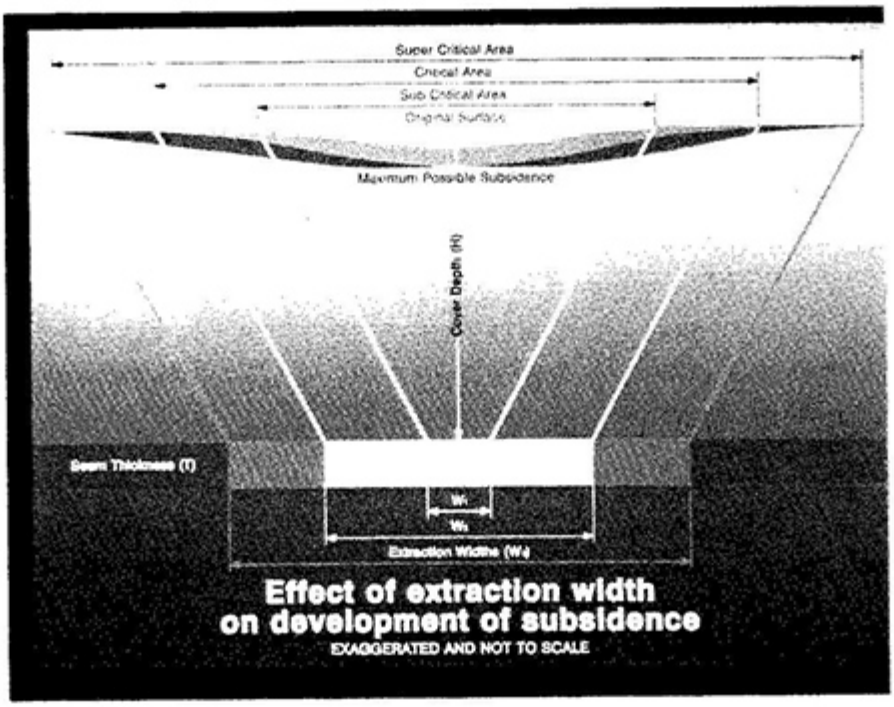


FIGURE 5



The effects of mining induced subsidence on the land surface above an area of full extraction.

4. INTERRELATION OF COAL MINING AND OTHER LAND USES

4.1 Effects of Mining on Other Land Uses

Land subsidence is commonly an unavoidable consequence of underground mining if mining is to be carried out economically. Restrictions on subsidence levels to protect natural or manmade structures can severely affect the economic viability of a coal deposit by limiting the percentage of coal recovered. Therefore, underground coal resources may have to be left unmined to protect surface structures. The entire coal resource, a significant part, only a limited part, or none of the coal resource may be affected, depending on the amount of subsidence that can be tolerated by the surface features.

Public perceptions of the risk of damage to property, particularly where longwall mining systems are proposed, have created pressure for increasingly stringent restrictions to be imposed on mining operations. Over the past 15-20 years, mine subsidence engineering in New South Wales has been developed to the point where accurate predictions can generally be made of potential mine subsidence; mining patterns can be designed to provide close control of subsidence. Some recent subsidence-induced damage in the Newcastle area was related to older mining practices.

The main issues of public concern with open cut mines are their effect on air quality, noise levels, aesthetics and the concern that the land may not be restored to a suitable condition. The development consent required by the mining proponents imposes conditions to address these issues. Rehabilitation is monitored by the Department of Mineral Resources and is of world class standard for coal mines in New South Wales.

4.2 Role of the Mine Subsidence Board

The role of the Mine Subsidence Board is important in determining the type of structures that can be built in areas likely to be affected by subsidence.

The Mine Subsidence Board's Charter is set out in the Mine Subsidence Compensation Act. It is designed to provide a scheme for the payment of compensation where improvements on the surface are damaged by subsidence following the extraction of coal or shale anywhere in New South Wales. Under the Act, the Board is subject to the control and direction of the Minister for Mines, reporting through the Minister to the New South Wales Parliament.

It also provides expert advice to property owners, government departments and authorities, local councils, community organisations and industries within 19 "Mine Subsidence Districts" and throughout New South Wales. This advice aims to provide compatibility between surface development and underground coal mining. To this end, the Board controls building and other surface development in Mine Subsidence Districts, setting building and construction requirements that provide protection from subsidence damage. These requirements cover the nature and class of improvements, including height, type of building materials used and the method of construction.

Mine Subsidence Districts are established in areas where potential incompatibility between surface development and coal mining operations needs to be controlled by the Board. The Mine Subsidence Districts are not restricted to areas of residential development. The Department of Mineral Resources administers "subsidence matters" outside Mine Subsidence Districts.

An important role of the Mine Subsidence Board is the elimination of public and private danger caused by mine subsidence.

Previously, research to reconcile the needs of coal mining with those of urban development concentrated on mine design and mining techniques developed to minimise the surface effects of subsidence following the extraction of underground coal in urban areas. However, if buildings can be made more resistant to subsidence, this will increase the level of extraction that can occur beneath the buildings.

An extensive research program, now completed, has been carried out into this issue, using funds provided by the National Energy Research, Development and Demonstration Council (NERDDC), the Mine Subsidence Board and the NSW Coal Association. The NERDDC grant was made to Elcom Collieries Pty Ltd and the NSW Coal Association. Australian Coal Industry Research Laboratories coordinated the project, with input from the coal industry, local government and the Department of Mineral Resources. The total cost of the project was $1.5 million. Some very promising results have emerged from the project and these should lead to the design and construction of houses able to withstand considerable levels of subsidence.

4.3 Land Uses Affecting Coal Mining

The close association of present day coal mining with the urban developments of Newcastle, Sydney and Wollongong will result in some land uses being affected by coal mining. In non-urban areas natural features may also be affected by subsidence. Open cut mines can affect some land uses and natural features.

In addition to these considerations which may limit coal mining, legislative constraints may give priority to some land uses over others.

The Working Party has compiled a list of land uses and environmental constraints that have, or could have, a significant impact on the development of coal resources in New South Wales.

Land Uses affecting Coal Extraction:-

Conservation Areas
Urban Development
Infrastructure
Stored Bodies of Water
Prime Agricultural Land
Commonwealth Land

Environmental Constraints:-

Natural Features
- Foreshores
- Escarpments
- Flood-prone Land
- Lakes

Heritage Sites
- Aboriginal Heritage
- European Heritage

Groundwater Resources

The effect that these land uses and constraints have on coal mining is explained below. However, it should be noted that a particular area could be affected by more than one category. For example National Parks might contain escarpments under which coal could not be fully extracted, even if mining was not prohibited by the location of the coal in a National Park.

4.3.1 Conservation Areas

Mining and private exploration ventures cannot be authorised in National Parks, Nature Reserves, Historic Sites or Aboriginal Areas after their dedication, except by specific Act of Parliament. It is possible for any reserve under the National Parks and Wildlife Act 1974 to be proclaimed to a limited depth e.g. Nattai National Park 60 m. In theory there would be no direct constraints to exploration and mining beneath any such reserve. However, in practice mining would be virtually impossible without access to the surface for

exploration and ventilation shafts. In addition subsidence effects would probably restrict mining recoveries to uneconomic levels.

National Parks are large areas set aside for their predominantly unspoiled natural landscape and flora and fauna. They are permanently dedicated for public education, recreation and inspiration and are protected from interference, other than essential management aimed at preserving their natural state.

Nature reserves are areas of special scientific interest containing wildlife or natural phenomena. Management practices are aimed at maximising the value of the area for scientific investigation and educational purposes. Historic sites are areas containing the sites of buildings, objects, monuments or landscapes of national importance.

Wilderness Areas may be declared under the National Parks and Wildlife Act or the Wilderness Act 1987. On Wilderness Areas proclaimed under the latter Act there are no specific restraints to mining or exploration. However, management principles contained in the Act, particularly that specifying "the absence of significant human interference" would effectively exclude mining and most forms of exploration.

Neither exploration nor mining is prohibited in a State Recreation Area. However, both the National Parks and Wildlife Act and the mining legislation include provisions that require consents from the Minister administering the National Parks and Wildlife Act before exploration or mining can take place. Mining does occur under some State Recreation Areas e.g. Burragorang State Recreation Area, but in all cases the mining preceded the declaration of the Recreation Area.

State Recreation Areas are permanently reserved large regional parks for outdoor recreation. They contain features of regional significance in a natural setting and can provide a range of recreational opportunities without detriment to the natural environment or cultural significance of the areas.

Legislation to create a new form of reserve (State Conservation Park) that would have included 90% of the area covered by State Recreation Areas was proposed in 1992 but later withdrawn. Some smaller State Recreation Areas used mainly for recreation have been transferred to the Department of Conservation and Land Management but these do not contain significant coal resources.

There are no specific constraints to mining or exploration on any of the other reserves under the National Parks and Wildlife Act i.e. protected archaeological areas, wildlife districts, refuges or management areas.

Areas defined in the World Heritage Listing have no legal status in New South Wales with regard to mining. However, public expectations would attribute to them a status similar to National Parks or other Conservation Areas. This would probably also be the case for areas listed on the register of the National Estate.

There are other natural features of environmental significance, such as areas of habitat and vegetation value, wetlands and hanging swamp that may be zoned for environmental protection under local plans. Conditions of mining leases and development consents commonly impose conditions to protect such features.

4.3.2 Urban Development

The New South Wales coal industry initiated early settlements such as Newcastle. As pressures for expansion around Sydney, Newcastle and Wollongong have grown, urban development has extended over some areas that contain substantial coal resources. Often the surface land requirement for urban expansion exceeds the rate at which coal can be extracted beneath that land.

In this report urban development has been used to cover a variety of land uses. These range from industrial and commercial with, for example, multi-storey structures, through suburban residential to rural residential, which might contain only one building per several hectares. The Department of Planning and local councils do not include rural residential within urban development. However, the Department of Mineral Resources was not able to differentiate these categories in its calculation of coal resources affected by these land uses. Therefore coal extraction in this category might vary from total, through partial to nil, depending on the density and type of buildings at the surface.

The decision on whether total extraction of coal should be permitted in an area with extensive urban developments largely depends on the likely 'extent of damage' to the improvements resulting from mining-induced ground movements. The 'extent of damage' in turn depends upon the level of ground movement and the type of structure. The level of ground movement depends on several factors:-

- depth of seam
- thickness of seam
- number of seams
- behaviour of strata above seams.

Occasionally coal resources cannot be developed unless land has been reserved for the necessary surface infrastructures. Transport corridors to coal development areas are also essential for servicing the mine whether by rail, road, conveyor or pipeline. In some areas the lack of access might impose greater constraints on mining than the presence of surface structures.

4.3.3 Infrastructure

(a) Railways

In the past, coal mining has not generally been permitted under infrastructure such as railway lines, roads, bridges and transmission lines. However, more information has become available on the effects of subsidence, from both local and overseas examples, and better designs of surface structures have been developed. The predictability of the degree of subsidence has also improved. It is now apparent that coal mining is often compatible with infrastructure, or the cost of repairing or preventing damage caused by mine subsidence is insufficient to prevent mining.

Historically, railways have been protected from subsidence due to mining by leaving substantial coal pillars under the line, through which only the driving of isolated headings was permitted. Many years of overseas experience in countries such as the United Kingdom and Germany have shown that, with careful management, mining and subsidence can occur with no effect on even high speed train lines. On the other hand circumstances arise where subsidence can restrict operating speeds (and hence line capacity) to a stage where costly disruption of services may develop.

After extensive consideration by an Inter-Departmental Working Party, which included examination of overseas practices, the State Rail Authority agreed to longwall mining under the Great Northern Railway at Teralba Colliery in the Newcastle Coalfield in 1991. Very thorough monitoring and several precautionary measures were taken during mining at the expense of the colliery and the Mine Subsidence Board. During mining, trains operated at reduced speed and to a special timetable. The mining was carried out with no adverse effects on the railway line. Another longwall panel at the colliery repeated this success in 1992.

These successful mining operations are considered a significant step forward for the utilisation of coal resources that are located under railway lines. As a result of these experiences the State Rail Authority

has completed guidelines for mining under railway lines. However, in other areas of the rail system, sensitive, damage-prone structures such as masonry-lined tunnels and masonry arch viaducts and overbridges exist. Such structures do not accept subsidence forces readily and therefore need to remain as areas for individual detailed study, on a structure by structure basis, where mining under railway lines is proposed.

(b) Transmission Lines

Pacific Power will deviate transmission lines at the request and expense of the mine operator. Temporary arrangements can also be made to allow mining to proceed under the towers. In either case the cost to the mining company is small, compared to the value of the coal extracted. Engineering solutions also exist in the design of transmission towers.

(c) Other Infrastructure

The serviceability of water, sewerage, gas and electricity supply systems cannot be interrupted by subsidence due to mining. Subsidence-induced tilts may change the gradients of tunnels, pipelines, surface and sub-surface drainage works. Tilts are particularly important in relation to structures carrying liquids that flow under gravity. If the design grade is flattened, then the flow may be impeded which could lead to public health hazards. Partial extraction may be required to avoid damage.

4.3.4 Stored Bodies of Water

Mining is restricted in zones around prescribed dams and their associated structures to prevent damage due to subsidence. Canals and tunnels associated with the Sydney water supply also have to be protected from damage due to subsidence. Mining has also been restricted under stored bodies of water because of concerns about leakage of water.

Significant coal resources are affected by stored bodies of water in the Southern Coalfield (1 075 Mt) but this is not the case in other coalfields.

The guidelines for mining coal beneath stored water bodies were framed during the 1970s. At the time there was a lack of confidence that reliable subsidence predictions could be made. Since the guidelines were framed, surface subsidence prediction techniques in New South Wales have improved considerably. In addition, research has also been undertaken on subsurface strata behaviour in mines. Because of this greater body of available data, mine layouts can now be engineered with confidence to limit surface movement to a specified level. The study of mine pillars which have been in existence for

many years has given valuable information on the design of stable pillar layouts.

South Bulli Colliery in the Southern Coalfield proposed some years ago to mine coal resources under the Cataract Dam storage area, but not under the dam structure itself. In respect to such an application, the Dams Safety Committee has certain statutory functions concerning coal mining operations that affect prescribed dams and their storage. The colliery carried out a thorough research program and demonstrated to the satisfaction of the Chief Inspector of Coal Mines and the Dams Safety Committee that partial extraction by longwall mining under the storage area could be safely undertaken. Approval has been given for mining under the water storage area of Cataract Dam.

When the mining at South Bulli commences, it will be comprehensively monitored. If the mining layout then proves to be conservative, the level of extraction can be increased. In the unlikely event that there is leakage from the dam, the mine workings can be effectively sealed to limit the water loss.

4.3.5 Prime Agricultural Land

Significant coal resources underlie prime agricultural land in the Hunter and Gunnedah Coalfields.

In the Hunter Valley restrictions have historically been applied to prevent coal mining beneath alluvial lands or within the floodplain defined by the 1955 Hunter River Flood. In a report on an Authorisation held by Coal and Allied Industries Ltd over an alluvial area near the Hunter Valley Mine, Mitchell McCotter and Associates Pty Ltd (consultants) noted that these restrictions have been derived from the *perceptions* that mining had the potential to cause the following:

- "disruption to agricultural production and a potential loss of high quality farm land;
- potential hydraulic impacts upon Hunter River flows, that is alterations to flooding characteristics;
- potential effects upon groundwater resources (loss of resource and quality deterioration); and
- effects on the quality of Hunter River waters".

Mining of "Agricultural Land", defined in the Mining Act 1992, has to be approved by the Director-General of the Department of Agriculture.

Experience of mining prime agricultural land in the mid and western USA is relevant to New South Wales, as the mining areas have similar climates, land use patterns and topography. Passage of the Surface Mining Control and Reclamation Act of 1977 imposed strict minimum standards for soil reconstruction and revegetation that apply throughout the USA. These performance standards are used as criteria for the release of reclamation bonds. The Act stimulated extensive research by the coal industry.

The avoidance of compaction of topsoil is one of the main technical requirements in overseas rehabilitation of prime agricultural land. This can be achieved by the employment of deep tillage machinery e.g. vibrating rippers which loosen replaced soils to depths of 90-120 cm. Recompaction can be minimised or eliminated through careful management practices and the injection of low-density soil additives into the voids created by deep tillage.

Technical and engineering expertise is available from dam construction and gravel extraction projects to provide design solutions to minimise the impact of mine construction on upstream and downstream land uses during flooding.

4.3.6 Commonwealth Land

Mining leases are not granted over Commonwealth land because it is outside the jurisdiction of the State to do so. However, the Working Party is not aware of any approach being made to the Commonwealth for permission to grant a mining lease over its areas. At Holsworthy in the Southern Coalfield, the Commonwealth owns the land to a depth of 30 metres, with the State Government having title over depths greater than 30 metres. Therefore, it would be possible for a lease to be granted for underground mining at depths greater than 30 metres.

Commonwealth land in the Singleton area containing significant coal resources has been used as a firing range. Before open cut mining or the installation of surface facilities for an underground mine could occur, the area would need to be rendered safe. If use of the area as a firing range were to cease, technology exists to locate unexploded ordnance and render the area safe for exploration and mining.

4.3.7 Natural Features

Only partial extraction of coal resources is permitted under some natural features, in order to protect them from damage due to subsidence e.g.

foreshores, cliff lines and flood-prone land. The Department of Mineral Resources has policies in place that do provide protection for natural features.

Subsidence due to mining of foreshores around bodies of water such as Lake Macquarie can result in damage to buildings or to the foreshores. In these circumstances only partial extraction of coal can be allowed. The Department of Mineral Resources has recently issued guidelines for mining beneath foreshores. These replace previous guidelines that had proved to provide inadequate protection in some cases e.g. Chain Valley Bay on Lake Macquarie. The latest guidelines draw upon the subsidence database that has been accumulated around foreshores, particularly in the Newcastle Coalfield, in recent years.

Total coal extraction under cliff lines can result in the collapse of the cliffs. The protection of cliffs may allow only partial coal extraction to be carried out.

The Department of Mineral Resources assesses proposed mine plans under escarpments to ensure that the escarpments are protected. It has recently undertaken a research program to better understand the relationship between mining and protection of escarpments. Results of this research will be applied to future applications for permission to mine under escarpments.

Even a small degree of subsidence of flood-prone land can have adverse effects on existing structures. Because of concern over the possible effects of mining-induced subsidence the Mine Subsidence Board commissioned a study of the Nepean River floodplain in the Camden area of the Southern Coalfield. This area is one of the key urban growth areas in the Sydney Metropolitan area. It also contains a significant deposit of high quality coking coal and has a history of frequent flooding. Although the coal resource is not well defined, the study found that subsidence of the Camden township area should not be permitted but mining could be allowed in other areas. However, additional work was required to define the coal resource of the area and the effect of subsidence on agricultural land.

4.3.8 Heritage Sites

Protection of European heritage sites such as historic buildings may be required if there is a likelihood of damage from mining operations. While most Heritage sites typically directly affect only small quantities of coal, they do have the potential to affect significant quantities of coal if restrictions on extraction are required for protection. This sterilisation of resources occurs because of the need to adopt inefficient mine layouts.

Significant archaeological areas containing Aboriginal relics are declared with the consent of the owner or occupier of the land on which they occur. These sites may require some protection similar to European heritage sites. These areas are administered by the National Parks and Wildlife Service.

4.3.9 Groundwater Resources

Intake beds for groundwater resources could also be affected by subsidence e.g. north of Newcastle. Perched groundwater resources in alluvial lands along the Hunter River could be subject to loss or disturbance from subsidence but generally only an insignificant quantity of coal is affected by groundwater resources.

5. COAL DEMAND AND SUPPLY

5.1 Introduction

The Working Party decided that it would help to place the coal resources of New South Wales in context by examining coal supply/demand scenarios at three different times: 2000, 2010 and 2020. Obviously, the longer the period, the less certainty there is of any conclusions that might be drawn. However, these three "snapshots" give some idea of the directions that the industry might take over the next thirty years.

At present 82 per cent of the world's primary energy is derived from fossil fuels - oil, coal and gas in descending order of use (in terms of oil equivalence). It is estimated that in 1990 coal provided as much as 47% of all the world's electricity. In the years ahead, its importance relative to oil and gas as the major source of primary energy will grow significantly. Coal has many attractions for less developed countries that are seeking to improve their standard of living. Such an improvement must be accompanied by great increases in the use of electricity, both industrially and commercially.

Nuclear energy has tended to fall out of favour as an alternative energy source following the Chernobyl disaster. Renewable energy sources are unlikely to make a significant contribution to electricity generation in the time span considered in this report.

Natural gas has less greenhouse impact than coal but supplies will limit the market share of this fuel.

Coal is abundantly available from a diverse range of competitive suppliers in over 40 countries, to provide fuel for electricity generation and steel production. Coal will continue to be the most economical source of the electricity needed for improved global living standards.

New coal technology has and will, in future, improve the efficiency of coal as an energy source. The modern usage of coal is clean and should not be seen as incompatible with environmental objectives.

For the reasons outlined above, world demand is forecast to be such that New South Wales can maintain the level of exports reached by 2000 for a further 20 years.

Several assumptions have been made regarding domestic and export demand that will affect all coalfields.

5.2 Domestic Demand

There will be no new large (gigawatt scale) coal-fired power stations, at least until 2001 and probably until 2005, after Mt Piper, which came onstream in 1993. The demand for steaming coal for power generation will remain close to current levels of about 20 Mtpa in the short term but could rise to about 24 Mtpa by the year 2001. The demand for electricity is expected to grow by about 2.6% p.a. up to 2001. Some of this growth will be met by improving the efficiency of the Pacific Power power stations. However, shortfalls in other States are predicted to occur in the 1990s when New South Wales has the capacity to export electricity on a contract or opportunity basis.

There will also be some contribution from smaller generating units such as fluidised bed combustion generators that use coal reject, from gas turbines and other sources. In addition, the Federal and State Governments' "no regrets" policy of reducing greenhouse gas emissions by improving energy efficiency (provided it does not impact adversely nationally or on Australia's trade competitiveness) will slow the growth in demand for electricity. A new large coal-fired power station is therefore unlikely to be required to meet New South Wales demand before 2005. Nevertheless, it is likely that in future, the introduction of large increments of generator capacity will be considered on a National Power Grid basis.

If a coal-fired power station were to be built, it would be located next to large reserves in an area where there is likely to be only limited, if any, land use competition. Potential coal reserves are present in the Oaklands, Narrabri, Rylstone and Ulan regions, so that there would be no impact on the current major coal producing areas. However, significant power generating capacity will remain in the Lake Macquarie and Hunter regions. There are no serious energy alternatives to coal in the short to medium term for New South Wales.

Domestic demand for coking coal for Australia, including Whyalla, has been stable at around 7 Mtpa since about 1987. It is assumed that this will decline in the medium term as further restructuring of the steel industry occurs. Changes in steel making technology will affect the likely composition of metallurgical coal demand, not only domestically but also in the export market. The use of pulverised coal injection (PCI) replaces some coking coal and reduces total coal requirements.

5.3 Exports

Forecasts made for export demand for coal in the Barlow Jonker report have been used to 2000, a period of substantial growth for steaming coal but little growth for coking coal. Beyond that period, steaming coal export growth for

New South Wales is assumed to be slow as the economies of Japan, Korea and Taiwan mature, although countries such as Thailand, Philippines, India and Pakistan may experience more rapid growth with an associated demand for steaming coal. No growth is expected in the European market for Australian coal because South Africa and the USA are likely to be the preferred suppliers. Forecasts by the Australian Bureau of Agricultural and Resource Economics (ABARE) made in early 1993 are similar to those of Barlow Jonker made a year earlier, although ABARE forecasts lower levels of exports of metallurgical coal and higher levels of steaming coal exports.

5.4 Supply

There are at least 10 new projects at advanced stages of planning in New South Wales, virtually all in the Hunter Coalfield. These projects, when combined with substantial expansions or extensions to existing mines, will meet the increased demand for New South Wales coal to the turn of the century. The prospects discussed in chapter 7 will form the bulk of the next generation of mines through to about 2010, if development is not constrained by other land uses. In forecasting supply from the various coalfields, some assumptions have been made concerning start-up times of the various projects. Statements made by the operators, evaluations made by the Department of Mineral Resources and the Barlow-Jonker demand forecasts form the basis for these forecasts.

It has been assumed that the decline in real coal prices of 2% per annum that has prevailed since 1979 will continue in the short term and then stabilise. No boost in the price of coal can therefore be expected which would stimulate new mine openings. figure 6 shows the contribution made by existing and proposed mines to meeting forecast demand. This figure also shows that a gap develops between supply and demand which will need to be met from new areas not yet identified as coal projects.

The forecasts also presuppose no quantum leaps in technology which would radically alter operating costs. The forecasts have been prepared on a coalfield by coalfield basis.

5.5 Newcastle Coalfield

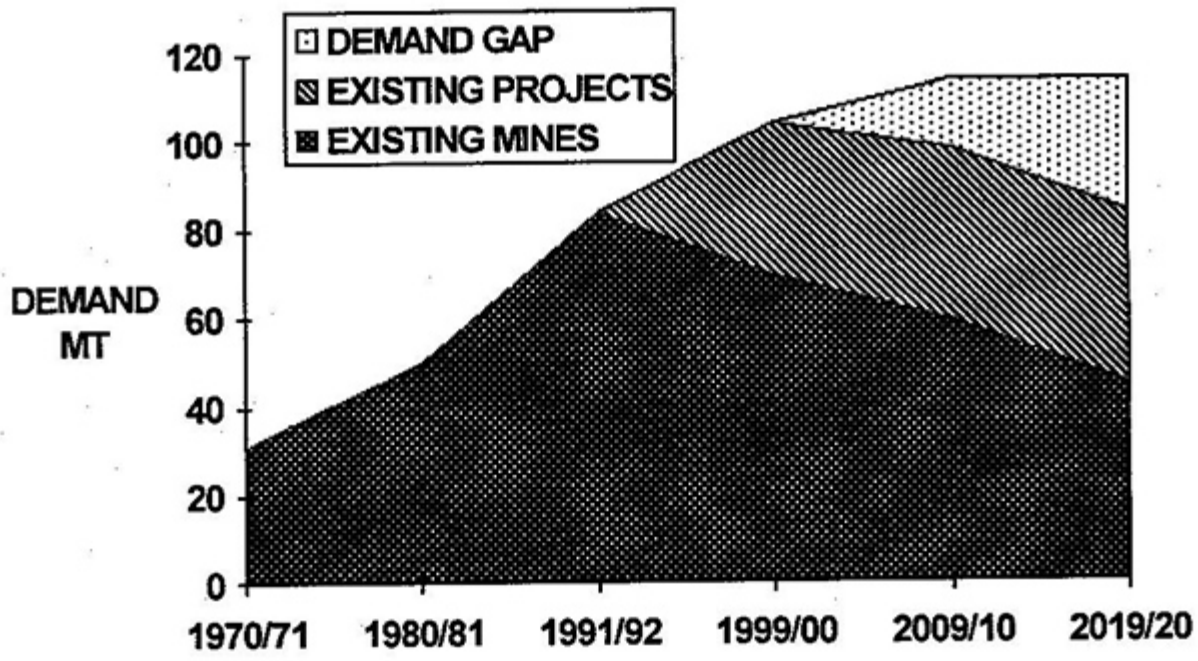
In preparing supply/demand forecasts for the Newcastle Coalfield the following assumptions have been made:-

- domestic demand of about 10 Mtpa for steaming coal will remain constant.

- domestic demand for coking coal will fall following some restructuring of the Newcastle Steelworks by 2000, although there could be some potential to offset this fall by increasing exports.

FIGURE 6

PROJECTED SUPPLY AND DEMAND FOR NSW COAL



The Working Party expects that production in the year 2000 will be less than at present with production from the new Lachlan mine being offset by the closure of some smaller mines. It is likely that by 2010 several mines will have closed because their economically recoverable reserves will have been exhausted. **The only possibility of a new mine opening to offset this decline in production is one in the Mandalong area but this is partially dependent on a decision being made on the use of this land.**

This pattern of mine closures will continue through to 2020. The number of mines will probably be less than half the current number, and production may be half the 1991-92 figure.

5.6 Hunter/Gunnedah Coalfields

This region is forecast to be the major area of new mine development and growth in production. Production is expected to increase from 1992/93 levels of 39 Mt to about 70 Mt by 2010 and will thereafter stabilise.

5.7 Southern Coalfield

Production from this area is expected to remain stable over the next 30 years at around 16 Mtpa. Although some mines will close as mineable reserves are exhausted, it is assumed that other mines will open to replace lost production. **However, it has also been assumed that access to the reserves needed to establish new mines will be able to be accommodated within closely developed areas in the Camden, South Creek Valley and Macarthur South areas (although current experience in the Picton area indicates this may not be easy). It has also been assumed that coal transport issues can be resolved.**

5.8 Western Coalfield

Production is expected to increase from the Western Coalfield to 17 Mt in 2000, largely from the contributions of Angus Place and Springvale Collieries. It is possible that one or more smaller collieries may close in this period.

Production is expected to remain at 17 Mtpa through to 2010 with perhaps one new mine opening (eg Airly Mountain) and some smaller mines closing as reserves are exhausted. However, there could be a decline of about 3 Mtpa in production by 2020 as some larger mines reach the limit of their mineable reserves. There are only limited resources available to allow the establishment of new mines. Production would be sufficient to supply Mt Piper and Wallerawang Power Stations and allow a limited tonnage for export. However,

there would be insufficient production to sustain a duplication of the Mt Piper Power Station.

5.9 Summary of Outlook to 2020

The following table summarises the demand for and supply of coal as envisaged up to 2020.

DEMAND

Year	Domestic	Export	Total
1991-92	27	54	81
2000	33	71	104
2010	33	81	114
2020	32	77	109

SUPPLY

Year	Newcastle	Hunter/ Gunnedah	South	West	Total
1991-92	17	38	16	13	84
2000	16	55	16	17	104
2010	12	69	16	17	114
2020	9	70	16	14	109

The production scenario by 2020 would be as follows:-

- Reduced production east of Cessnock.
- Increased production around Muswellbrook with some decline towards Singleton.
- Substantial growth in the Gunnedah district.
- Replacement of several mines in the Southern Coalfield by mines in the Picton-Camden area.
- Reduced exports from the Western Coalfield with the possibility of insufficient reserves locally to supply the power stations much beyond 2020.

6. REGIONAL EFFECTS ON COAL RESOURCES BY COMPETING LAND USES

6.1 Introduction

The Australian Code for Reporting Identified Coal Resources and Reserves (February 1986) defines Coal Resources as:

"All of the potentially usable coal in a defined area", that is all the coal in an area that has, or could be processed to give, a quality acceptable for commercial usage in the future.

Coal Reserves are those parts of the Coal Resources for which sufficient information is available to enable detailed or conceptual mine planning and for which such planning has been undertaken. **It is important to note that only a fraction of the Coal Resources is ultimately able to be mined.**

In 1986 the Department of Mineral Resources and the Joint Coal Board estimated the coal resources in the State's coal-bearing regions at 80 thousand million tonnes. Resources were defined in this assessment as coal with an in situ ash content of less than 35 per cent, at depths of 600 metres or less and where exploration allowed continuity between observation points to be established. There was insufficient information in some areas to include coal resource estimates in the above total. The 1986 study also included estimates of the amount of coal affected by other land uses such as National Parks. However, again in some areas there was insufficient information to estimate the resources affected. **It should be noted that the definition of coal used in the 1986 study includes large tonnages that would be substantially <u>below economic quality</u> at today's prices.**

For this study the Department of Mineral Resources has broadly estimated coal resources currently affected by other land uses. The Working Party considered that such a broad estimate of tonnages by the various categories was sufficient for its purposes.

Tables have been prepared for each coalfield which show tonnages of coal affected by the competing land uses discussed in chapter 4. In each case the resource estimates are divided into "major seams" (seams currently mined) and "minor seams" (seams not considered economic at present).

The Coal and Petroleum Geology Branch has also prepared maps showing the extent of various land uses in the different coalfields (figures 7-11). On the same maps, coal resources have been shown in the following categories:

- Colliery Holdings
- Unallocated High Potential Coal Resources
- Short Term Potential
- Medium Term Potential
- Other Coal Resources

"Short term potential" was taken as resources likely to be developed within 5 years, "medium term potential" 5-15 years and "other coal resources" may be developed after 15 years or are unavailable for development. Colliery holdings were shown separately because development of coal resources within these has some priority over other land uses and is less likely to be constrained.

"Unallocated high potential coal resources" are those resources likely to be the basis of future mining developments. These are the key resources which need to be preserved to ensure that the NSW Coal Industry has the resource base to meet future industry growth.

An examination of the maps shows that in every case there are very large areas classified as "other coal resources" that in many cases not affected by other land uses. This could give the impression that New South Wales has virtually unlimited coal resources to ensure the future of the coal industry indefinitely. However, there are several factors that have to be considered in assessing these resources.

- The areas have generally been only lightly explored, so that there is no certainty that economic coal resources exist within the area.
- The resources are generally of a quality that is uneconomic under present prices and mining technologies. Otherwise, there would have been more intensive assessment.
- Coal prices, like those of other commodities, have been declining in real terms for many years e.g. steaming coal has declined by an average of 2% per year since 1979 and this historical trend will probably continue. Therefore resources which are uneconomic at today's prices are unlikely to become economic through price rises.

- Quantum leaps in technology would be necessary to allow lower grade resources to be mined but incremental improvements in technology and more efficient work practices are more likely. These will improve productivity sufficiently to offset falls in the real coal price.

- Much of these resources are not within easy reach of infrastructure. The cost of providing that infrastructure would be beyond the funding capacity of potential mines in the area.

- Only a fraction of coal resources are eventually mined because of difficult mining conditions, uneconomic quality and other reasons.

Problems peculiar to each coalfield are discussed in the following sections that tabulate the resources affected by other land uses on a coalfield by coalfield basis.

6.2 Newcastle Coalfield

The criteria used to define coal resources in the Newcastle Coalfield are 1.5 metres minimum seam thickness, 35% maximum raw coal ash content and 600 metres maximum depth.

The following table lists the coal resources that are currently affected by other land uses.

Coal Affected by Other Land Uses - Newcastle

Land Use	Major Seam (Mt)	Minor Seam (Mt)
National Parks	190	100
Urban Development	1 100	650
Infrastructure	160	30
Natural Features		
Lake Foreshores	675	450
Flood-prone Land	300	550
Total	**2 425**	**1 780**

The towns of Lake Macquarie and Wyong both lie within the Newcastle Coalfield. The amount of extraction under urban development varies from 100%, where deep seams are mined under rural residential areas, to the first workings stage only, where shallow seams are mined under substantial surface structures. However, an average of 50% extraction for the Newcastle Coalfield

is considered reasonable if it is remembered that the percentage of extraction can vary widely from this figure. Therefore, it is assumed that 550 Mt of coal in areas of urban development can be extracted and 550 Mt can not. Some coal can be extracted under natural features but it is difficult to determine a percentage.

An important point to note on figure 7 is that there has been extensive mining on the eastern side of Lake Macquarie. As a result there are virtually no coal reserves left in the colliery holdings covering this area. A similar situation exists north of Lake Macquarie to Newcastle.

Figure 7 also shows several small, scattered urban developments on the western side of Lake Macquarie. Although these areas are small they do limit the level of coal extraction in some collieries with resulting restrictions on the design of mining plans. This affects the economic mining of substantial tonnages of coal, which in turn affects the availability of coal for mining beyond the areas identified as urban development. Some of these areas of urban development also include foreshore or flood-prone land that could not be shown separately at the scale of the map used.

Much of the area included in colliery holdings south of Cessnock has already been mined, while the sulphur content of some of the remaining coal is above levels that are environmentally acceptable for use as steaming coal.

Lake Macquarie and the Tuggerah Lakes have about 250 kilometres of foreshores. This is the reason for the tonnage of coal in this category, while flood prone land is associated with the major drainage systems into these lakes.

The total coal resource in the Newcastle Coalfield is estimated at greater than 10,700 Mt after some updating of figures in the 1986 NSW Coal Resource and Reserves study. Therefore, about 39% of the total coal resource is affected by the land uses as detailed in the table above. The 1986 study noted that 367 Mt of coal was contained in seven closed collieries, while information was not available for a further five.

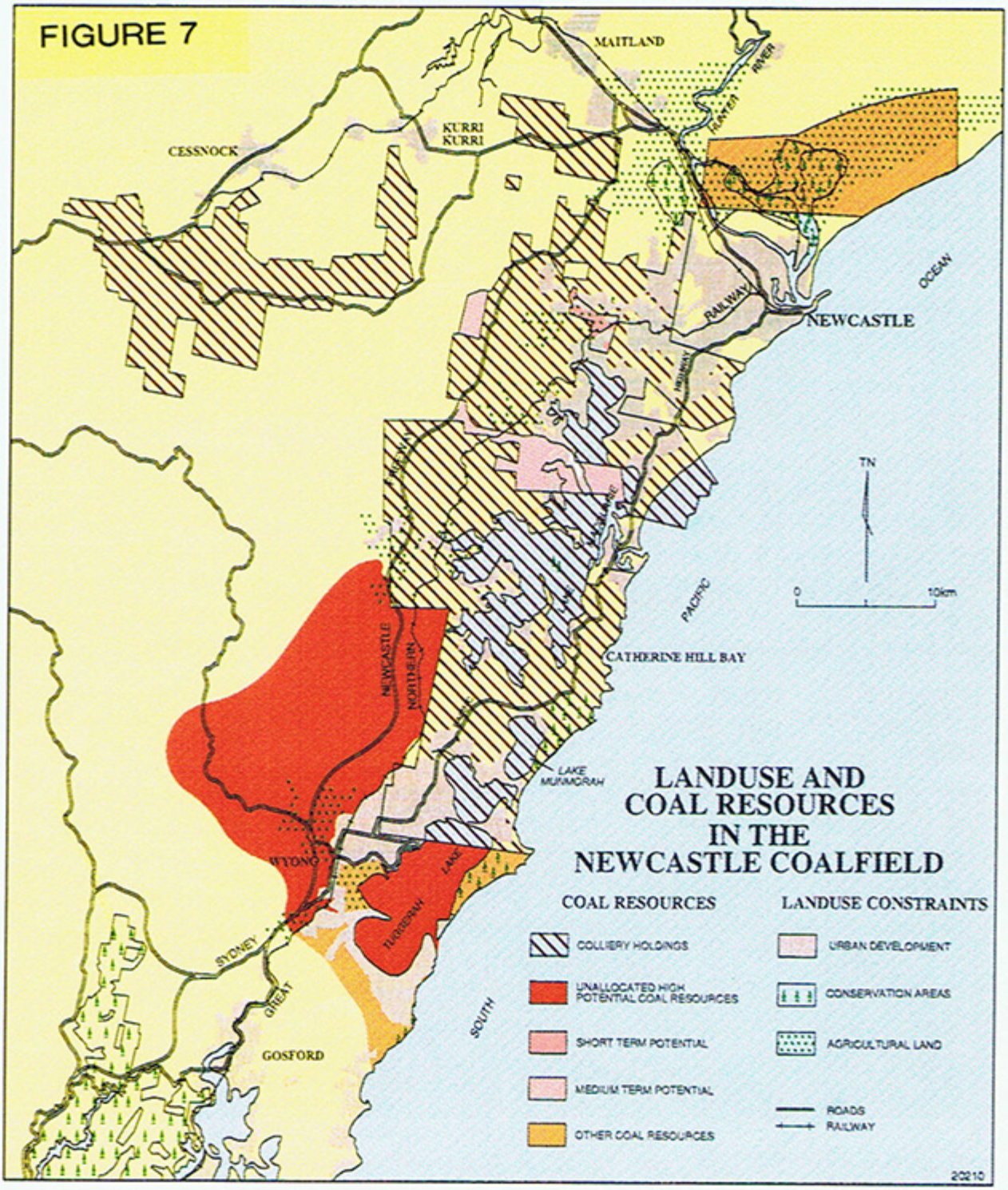
6.3 Hunter Coalfield

The criteria used to define coal resources in the Hunter Coalfield are 1.5 m minimum seam thickness, 35% maximum raw coal ash content and 600 metres maximum depth.

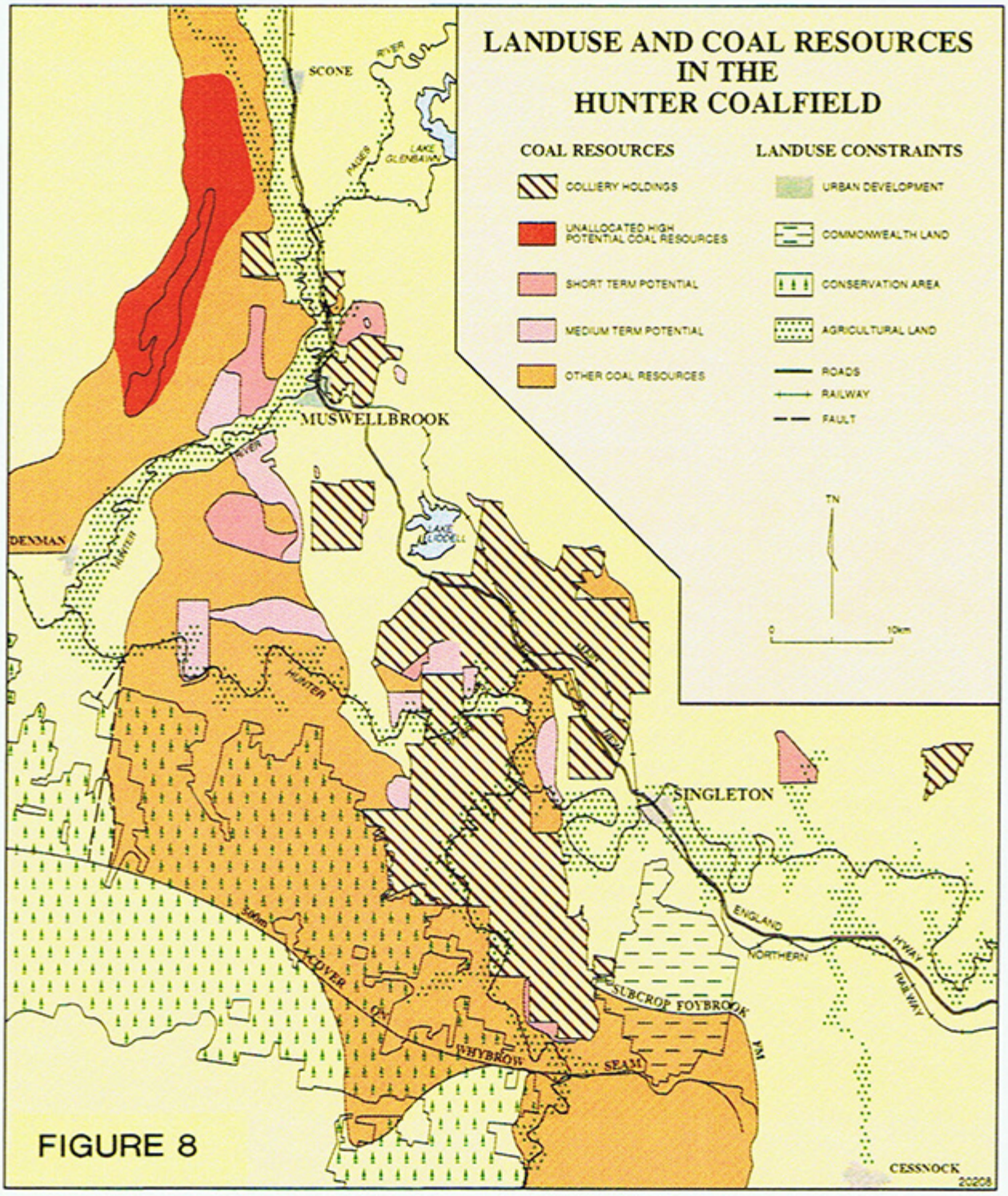
The following table lists the calculations by the Department of Mineral Resources of coal currently affected by other land uses.

Coal Affected by Other Land Uses - Hunter

Land Use	Major Seam (Mt)	Minor Seam (Mt)
National Parks	12 000	6 700
Urban Development	245	
Infrastructure	185	
Water Storage	85	
Prime Agricultural Land	3 500	
Commonwealth Land	3 200	
Natural Features	25	
Total	**19 240**	**6 700**



Effects of Land Use on Coal Resources - NSW 1994 - p 40.jpg



Effects of Land Use on Coal Resources - NSW 1994 - p 41.jpg

The tonnages in the table represent about 42% of the total coal resources of the Hunter Coalfield, which were assessed as 61 100 Mt. This figure was derived by revising the 1986 study of the coal resources of New South Wales with the figures determined for the National Parks, Urban Development and Prime Agricultural Land categories in this report. Generally, the resources west of Scone, Muswellbrook and Denman have only been subjected to limited exploration.

The Wollemi and Yengo National Parks overlie the western boundary of the Hunter Coalfield and contain the bulk of the coal currently affected by other land uses.

Prime agricultural land associated with the Hunter River floodplain, and the protection of associated groundwater resources within the alluvial deposits of the floodplain, affects a significant percentage of the coal resource. Some coal that would be affected by natural features is already constrained by National Parks.

Part of the Commonwealth land associated with the Singleton Army Base is used as an artillery firing range. All of the coal resource is located in that part of the Commonwealth land used for the firing range (see figure 8).

6.4 Gunnedah Coalfield

The parameters used to define coal resources for this study are minimum seam thickness 1.5 metres, raw coal ash less than 35% and depth of cover less than 600 metres.

The following table lists the quantity of coal currently affected by other land uses, as determined by the Department of Mineral Resources. Coal resources have been categorised as prime (ie suitable for export) and domestic quality to reflect the variability in quality of individual coal seams in the Gunnedah basin rather than dividing coal into major and minor seams.

Coal Affected by Other Land Uses - Gunnedah

Land Use	Prime Quality (Mt)	Domestic Quality (Mt)
National Parks	1 000 +	1 000 +
Prime Agricultural Land	7 500 +	8 500 +
Total	**8 500 +**	**9 500 +**

There is less data coal resources in this area than, say, for the Hunter. This has led to more uncertainty in calculations of the tonnages affected by the land uses listed above. Total resources in the Gunnedah Basin are about 38 000 Mt, with almost 50% affected by other land uses.

The Gunnedah Coalfield is 320 km from the port of Newcastle, compared with Singleton which is much closer at 90 km. This adds a cost to the rail freight of coal to the port that in turn requires high quality and/or lower cost mining conditions to compensate. In the past, the Gunnedah Coalfield was seen as having great potential for large open cut coal mines that could be cost competitive with mines closer to the coast. However, drilling by the Department of Mineral Resources virtually eliminated these potential resources because of thick alluvial cover in the zone of prime agricultural land, diminution of quality because of igneous intrusions, or indeed absence of the coal seams. It must be questioned whether much of the underground coal resource of the Gunnedah Coalfield will ever be mined (see figure 9).

6.5 Southern Coalfield

Premium quality coking coal is obtained from the Bulli and Wongawilli Seams that supply both export markets and the domestic steel industry. Export quality thermal coal is also obtained from both of these seams, which would be classified as major seams.

Two other seams, the Tongarra and Balgownie Seams, have been mined in the past but are not currently mined (minor seams). All four seams have been considered as a coal resource in the Southern Coalfield.

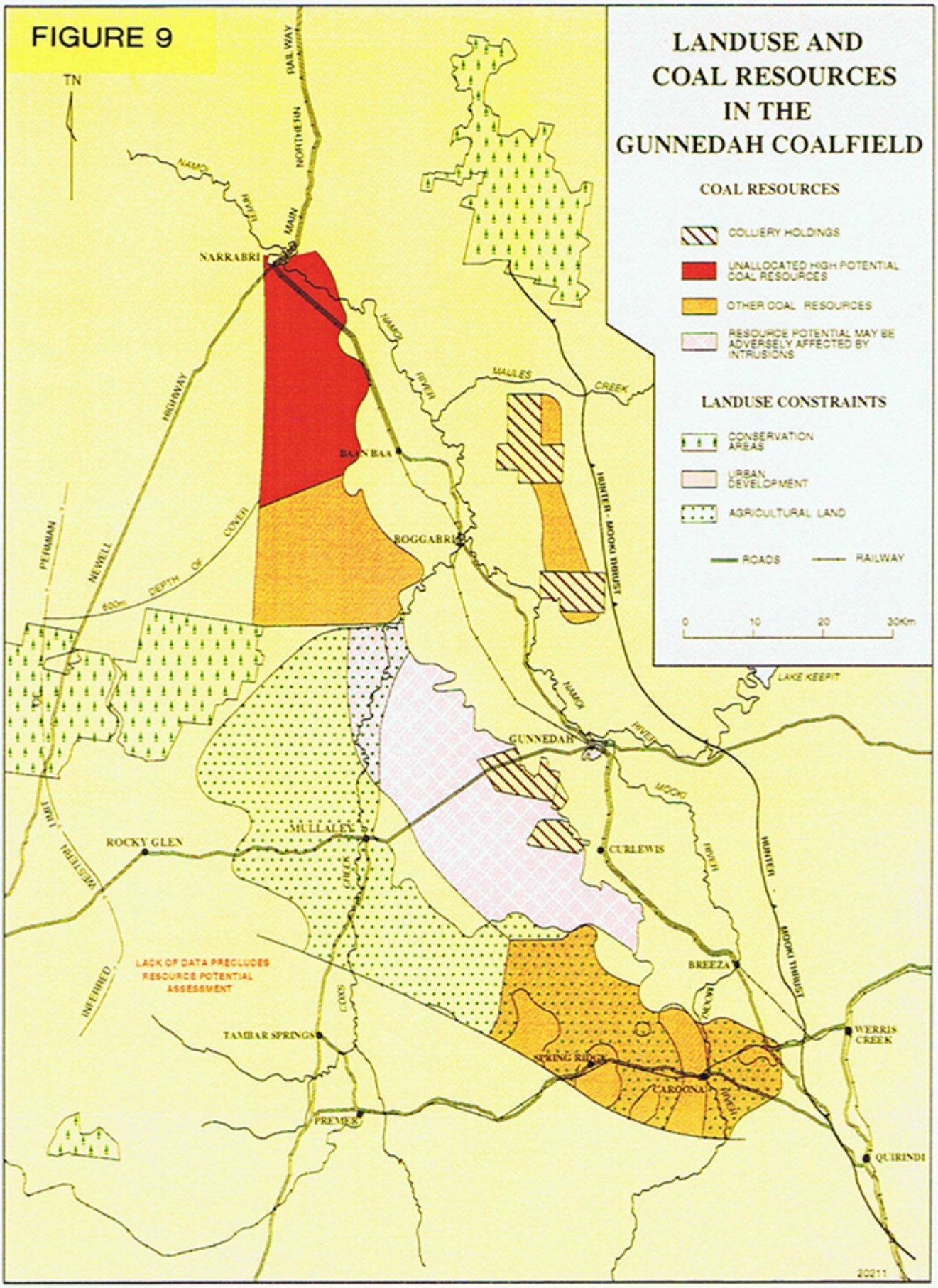
Coal in the Southern Coalfield has been considered as a resource if there is a minimum seam working section thickness of 1.5 metres and a maximum 35% ash content for raw coal. No limits were placed on the depth of coal, because mining is likely to occur over the next decade at depths of greater than 550 m.

The following table lists the quantity of coal affected by other land uses, as determined by the Department of Mineral Resources.

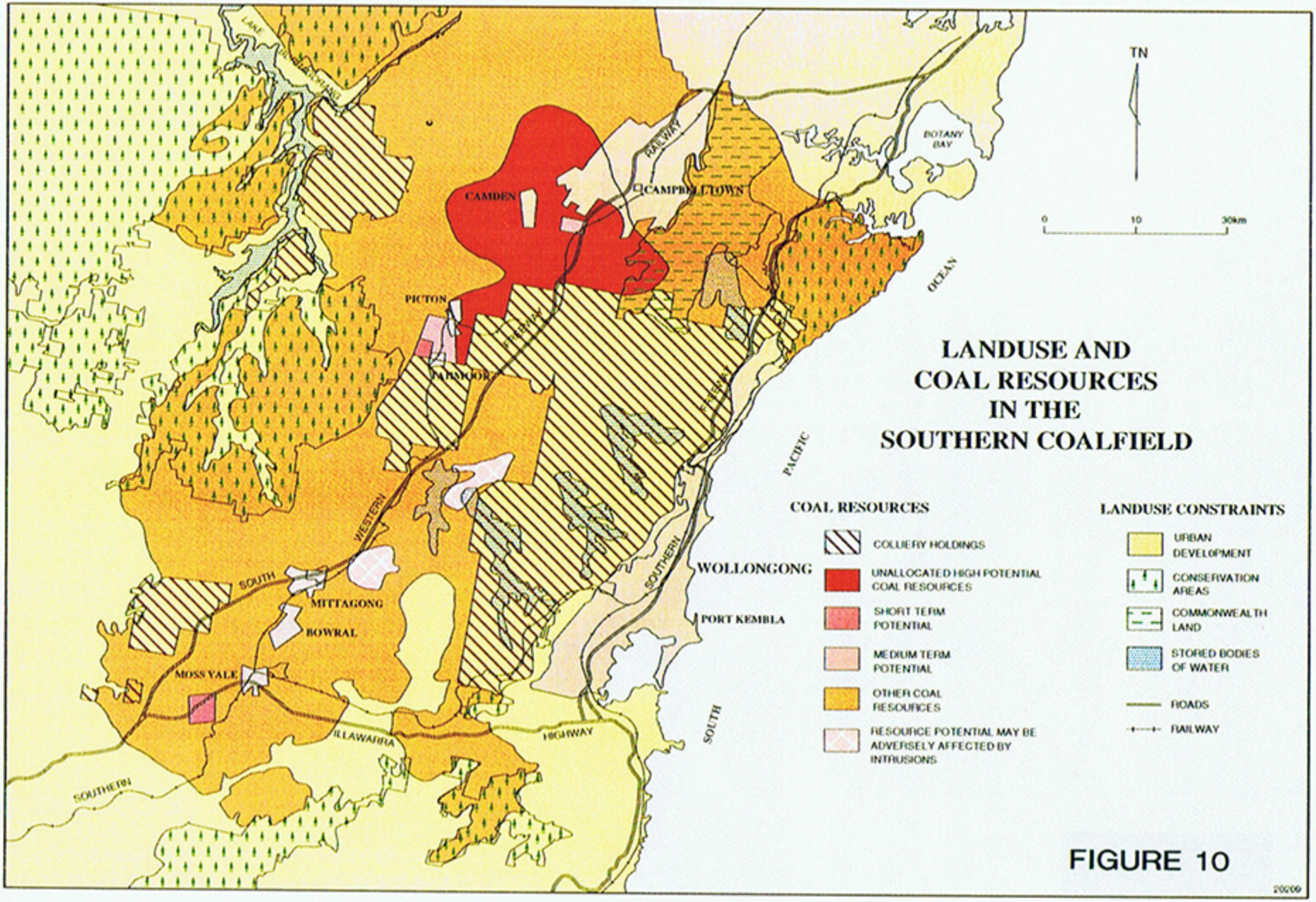
Coal Affected by Other Land Uses - Southern

Land Use	Major Seam (Mt)	Minor Seam (Mt)
National Parks	935	520
Urban Development	minor*	
Infrastructure	550	210
Stored Waters	1 075	255
Commonwealth Land	75	300
Natural Features	140	25
Total	**2 775**	**1 310**

* Because coal mining in the Southern Coalfield generally takes place at a greater depth than in other areas of the state, the effect of subsidence on urban developments is reduced.



Effects of Land Use on Coal Resources - NSW 1994 - p 45.jpg



The total coal resource in the Southern Coalfield is 17 045 Mt. About 24% of this resource is affected by the land uses identified in the table.

There are several National Parks in the Southern Coalfield that contain coal resources; the Royal National Park contains about half the coal affected by National Parks.

The Southern Coalfield is host to an extensive catchment area and a major water supply system for Sydney and the South Coast e.g. the Upper Nepean Scheme and the Warragamba Dam. The coal resource of 1 075 Mt in the table refers to coal under the stored waters and dam structures.

There are three main railways within the Southern Coalfield - Main Southern Line, Illawarra Line and the Unanderra to Moss Vale Line.

Resources in the Holsworthy army area are very poorly known with only sparse drilling results. Further drilling will be undertaken in the short term.

Mining has taken place on the Southern Coalfield for more than 100 years with the result that substantial parts of the colliery holdings east of the South Western Freeway have been mined out. Remaining coal resources are generally at greater depths than in other coalfields with associated higher costs. Therefore, it is unlikely that steaming coal, a lower priced commodity than coking coal, can be economically mined. This would also eliminate some long term resources (see figure 10).

6.6 Western Coalfield

Coal in the Western Coalfield has been considered as a resource if there is a minimum seam thickness of 1.5 metres and a maximum 35% ash content for raw coal. A depth restriction of 600 metres was applied. The major seams comprise the Lithgow, Lidsdale, Irondale and Katoomba Seams. The tonnage of coal affected by conflicting land uses is detailed in the following table.

Coal Affected by Other Land Uses - Western

Land Use	Major Seam (Mt)	Minor Seam (Mt)
National Parks	11 410	11 230
Natural Features	Insignificant	Insignificant

The total coal resource in the Western Coalfield is 29 963 Mt, with coal in National Parks comprising 76% of the total.

The Western Coalfield is overlain to the east by the Blue Mountains, Wollemi and Goulburn River National Parks, for which data to calculate tonnages of contained coal are very sparse and limited to the margins of the declared areas. The Springvale, Angus Place and Airly Mountain coal deposits underlie escarpments where restrictions on coal extraction have been required to protect the natural features (see figure 11).

6.7 Summary

The following table compares the total coal resource in the various fields with the coal affected by other land uses.

Field	Total Resource (Mt)	Resource Affected (Mt)	Resource Affected %
Newcastle	10 700	4 205	39
Hunter	61 100	25 940	42
Gunnedah	38 000	18 000	47
Southern	17 045	4 085	24
Western	29 963	22 640	76
	156 808	**74 870**	**48**

It is also instructive to tabulate the coal resource affected by the various land uses.

Land Use	Million Tonnes	% of Total
National Parks	45 085	59
Urban Development	1 995	3
Infrastructure	1 135	2
Natural Features	2 165	3
Stored Bodies of Water	1 415	2
Prime Agricultural Land	19 500	26
Commonwealth Land	3 575	5
Total	**74 870**	**100**

Similar percentages are obtained if only the coal resources in major seams affected by other land uses are calculated. It must be remembered that the resources in National Parks, prime agricultural land and Commonwealth land are poorly known and are based on very limited data.

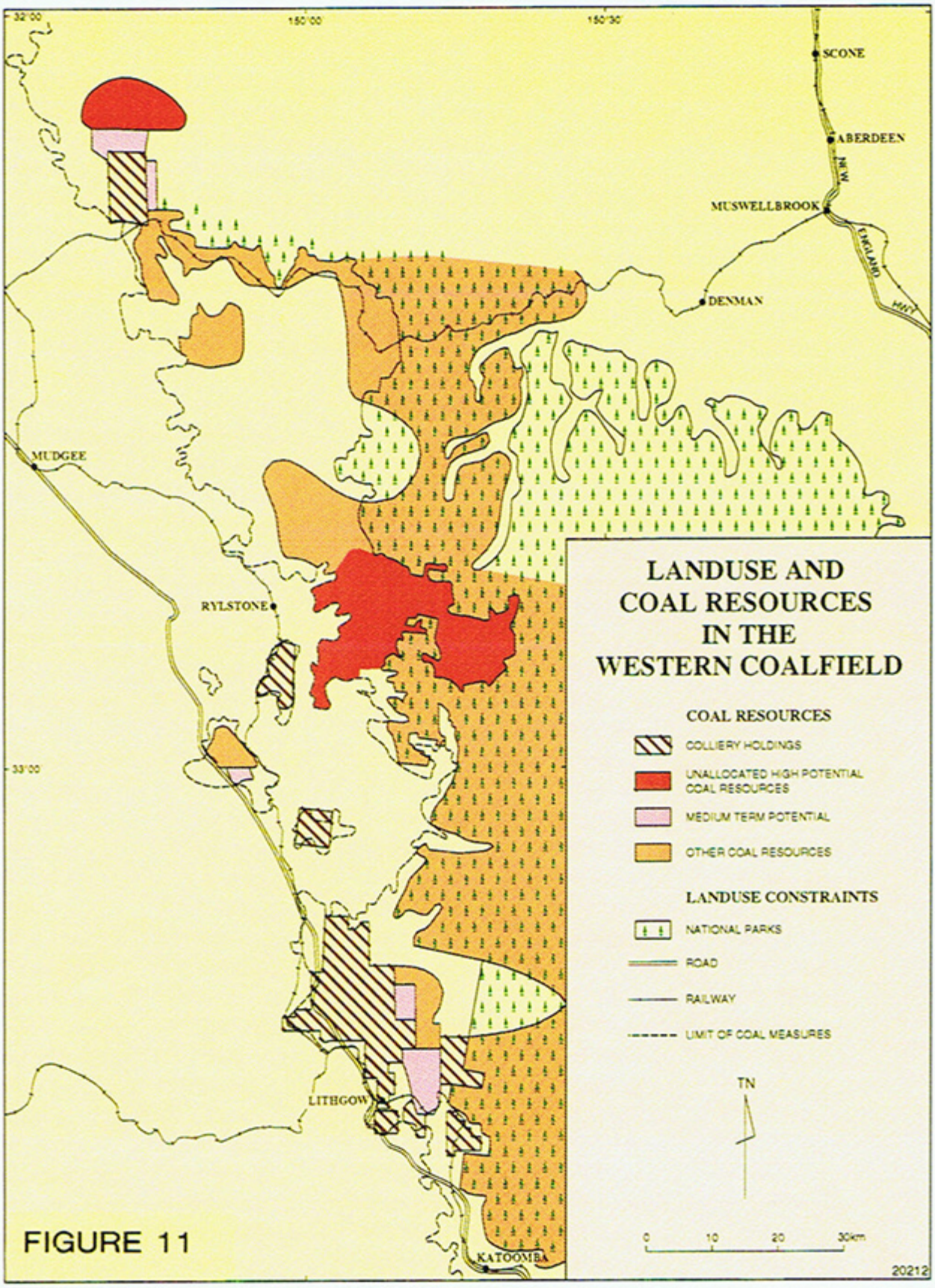


FIGURE 11

Effects of Land Use on Coal Resources - NSW 1994 - p 49.jpg

7. STRATEGIC COAL DEVELOPMENT PLAN

7.1 Introduction

This report has demonstrated that competing land uses already affect significant areas of known coal potential. The scale of this effect is only poorly understood outside the coal industry. Most people would assume that mining is by far the most significant reason for the depletion of coal resources in New South Wales. However, since coal mining commenced in NSW in the late 1700s less than 5 thousand million tonnes or only about 3% of the State's total coal resource has been depleted due to mining. This compares to about 74 thousand million tonnes, or 50% currently affected by land uses perceived as incompatible. Most of this impact has occurred in the last 40 years. Continued access to economic coal resources in New South Wales will require commitment to a range of strategies aimed at minimising the impact of competing land uses on coal resources.

To address these issues this report proposes a **Strategic Coal Development Plan** that presents strategies for addressing coal resources in:

- **Existing mines**
- **Project areas**
- **Areas that will form the resource base for new coal mine development.**
- **Other areas**

It is vitally important to preserve access to key coal resource areas. Demand studies indicate that there is a need for new mine development to ensure that New South Wales is in a position to meet domestic coal demand for power generation and the steel industry, as well as being able to supply the growing export demand for New South Wales coal. Coal's position as a fundamental commodity, underwriting much of the State's economic development, demands that careful consideration be given to future coal supply and that action be taken to secure strategic resource areas.

The previous chapter catalogued the effect on coal resources of various land uses which are already in existence. This chapter attempts to document some impacts which future development may have in each coalfield, particularly in respect of high value coal resources.

Most of the land use categories cover areas which are well defined e.g. natural features, water storage, prime agricultural land, Commonwealth land and large infrastructure elements. However, two categories can expand as planning decisions are made - National Parks and urban development. Both land uses have the potential to affect high value coal resources. The only major infrastructure development proposed in recent years that could have affected large tonnages of coal resources is the Very Fast Train project, but this is now dormant, if not abandoned.

As stated previously the growth of Newcastle, Sydney and Wollongong as major industrial centres can be attributed in a large part to the presence of coal. The coal industry has also benefited by easy access to ports through well developed transport infrastructure, a skilled workforce and sophisticated engineering support.

However, as these urban centres grow and tend to coalesce with their surrounding satellite centres, there is an ever increasing pressure on the accessibility and availability of coal resources in these areas.

Also, requirements of the expanding populations for recreation areas have led to an expansion in conservation areas around the cities that can also affect coal resources. The declaration of the Nattai National Park in the Southern Coalfield is a recent example.

Some very significant studies on plans for urban development are now being undertaken which will have major implications for the coal industry. The Department of Planning is updating its Metropolitan Strategy that was published in 1988. A discussion paper entitled Sydney's Future has recently been released by the Department of Planning. This paper acknowledges the significance of coal and methane resources in the area. At the same time an Integrated Transport Study is being prepared by the Department of Transport. The area covered by these studies extends from the Lower Hunter and Newcastle, south to the Northern Illawarra. The Macarthur South Study covering south-western Sydney and the draft Hunter Coastal Urban Settlement Strategy will be considered as part of the larger Metropolitan Strategy. Substantial coal resources occur in the area covered by the Metropolitan Strategy, a fact that is an important part of the Department of Planning's deliberations.

Proposals for new conservation areas or extensions to existing conservation areas have been made which have not been implemented. As these areas presumably have qualities to warrant their being proposed as conservation areas, it is possible that they may be proposed again in the future. Some assessment has also been made of coal resources contained in such areas.

Possible land use changes for each coalfield have been considered and particularly their effect on high quality coal resources. A map (enclosure 1) has been prepared showing those deposits that are considered to have high potential to be developed as stand-alone mining developments in the future.

7.2 Newcastle Coalfield

Existing Mines

In 1992-93 production from the Newcastle Coalfield amounted to 16.9 Mt. Of this total, 8.2 Mt was delivered to power stations in the district, 7.9 Mt was exported and 1.0 Mt was supplied to the steel industry. The balance was incorporated into stock piles. The closures of Pelton and Newvale No 1 have occurred recently; Awaba is likely to close and production from Wallarah and Moonee has been curtailed. These decisions have led to reduced production from the Newcastle Coalfield.

The Ulan mine near Mudgee was awarded a contract to supply Eraring Power Station from January 1993, which has required the construction of a rail unloading facility. This rail unloader will increase the competitiveness of mines outside the Newcastle area with the potential for further loss of domestic markets by local mines.

High levels of population growth have been maintained along the New South Wales coast over the past few decades. There is a strong trend toward increasing settlement in the coastal areas of Lake Macquarie and Wyong local government areas. In particular, development on the western side of Lake Macquarie is of most concern in respect to the possible impact on coal resources (see figure 7).

In most cases urban development on the western side of Lake Macquarie is affecting existing mines. The direct impact on existing mines is to limit planning options by constraining longwall mining layouts, thereby reducing productivity by restricting the amount of coal that can be recovered. Each constraint imposed on a mining operation increases the cost of that operation. The mines in the Newcastle area are particularly vulnerable because of their age (many have operated for over 50 years) and dwindling resources of high quality coal. Many mines have substantial resources of poorer quality coal in lower seams (Fassifern Seam in particular). However, the economics of extracting this coal in the face of increased constraints being imposed by surface development are doubtful.

The recent closures and cutbacks at several mines are in part a reflection of the increased costs associated with mining in the Newcastle coalfield.

Project Areas

Project proposals are limited to Bellbird near Cessnock and Lachlan on the western side of Lake Macquarie. These projects could be expected to be developed in the medium to longer term. However, production from these projects would be insufficient to make up for lost production from mine closures in the Newcastle Coalfield.

Future Coal Development Areas

The options for new mine developments in the Newcastle Coalfield are limited.

The Mandalong area north west of Wyong (figure 7) contains high quality steaming coal that at one time was reserved for a power station. This area contains probably the **last significant, high quality thermal coal resource in the Newcastle area**. The resource of 450 Mt is thought to be sufficient for two underground mining developments. However, the area is under increasing threat from rural residential development. In particular Wyong Council has strenuously opposed restrictions on development in the area, particularly where the coal measures deepen south of the 400 m depth of cover line, which is in the southern part of the area indicated on figure 7.

The Department of Planning prepared a discussion paper on the draft Hunter Coastal Urban Development Strategy early in 1992. This report included a map showing areas for potential urban development. However, the report noted that the sterilisation of productive coal resources needs to be avoided. The resources in these areas have been calculated at about 140 Mt in the major seams. These resources would be exploited from existing collieries. However, mining in the largest of these areas (Edgeworth) should be completed in five years. As full development of the area is likely to be spread over 30 years, coal mining and urban development should be able to be coordinated to allow both land uses to occur.

7.3 Hunter and Gunnedah Coalfields

Existing Mines

In 1992-93 production from this area amounted to 39.1 Mt and has been growing for the last decade. It has been the fastest growing area of coal production in the State over this period. Of this production, 29 Mt were exported and 10 Mt was sold to power stations.

There has been a great expansion of mining operations, particularly open cut, in the Singleton-Muswellbrook area in the last decade. As discussed in chapter 2, residents of this district were initially concerned at the effect which large scale mining developments would have on their lifestyle.

The Hunter/Gunnedah area does not contain significant areas of urban development. However, the major regional centres, particularly Singleton and Muswellbrook and the surrounding smaller settlements, do have a significant impact on potential coal development in the region. Residents of these centres commonly express concern over open-cut mining developments. Major issues of concern include dust, noise, water quality, visual impacts and general loss of amenity.

Project Areas

Several major coal projects are now in various stages of development near Muswellbrook e.g. Dartbrook, Bengalla, Mount Arthur North and Mount Pleasant. For these projects to proceed it is essential that proponents of projects in the Muswellbrook district demonstrate that they can mine in an environmentally sensitive manner and can resolve concerns held by local communities.

Several consultative processes have evolved over the last 15 years to allow residents' concerns to be addressed. For example an Environmental Impact Statement (EIS) has to be put on display to inform residents of the details of proposed developments. A Commission of Inquiry is held if there are objections, which allows residents an opportunity to explain why they oppose mining. Conditions can be imposed by the Commissioner on the development to meet these objections. An Environment Monitoring Committee, which has community representation, was established for the Rixs Creek mine near Singleton.

The Working Party expects that production from the Hunter region, resulting from the development of existing project areas, in the year 2000 will have grown by about 17 Mt. While some existing mines may close, it is expected that this loss of production will be more than offset by up to 9 mines opening in the same period. It is likely that production will continue to grow through to 2010 to about 69 Mt with a further 5-6 mines opening and a small number of closures.

There are also two large open cut mining proposals in the Gunnedah district, Maules Creek and Boggabri. However, these projects will require major improvements to rail capacity between Gunnedah and Muswellbrook, particularly the rail link over the Liverpool Range, before these projects could

be developed to their full potential. The development of new export mines in the Gunnedah region will require efficiencies of scale to justify the increased transport costs e.g. production of 5-10 Mtpa to offset the greater distance to port, 300 km compared with 125 km from Muswellbrook.

Future Coal Development Areas

Significant coal resources of high quality coal are contained in Authorisation 102 (figure 8) held by the Department of Mineral Resources west and north of Muswellbrook. Some disquiet has been expressed by residents that their lifestyle will be adversely affected if all the coal resources in this area are developed. It is estimated that sufficient resources exist in this area for a further 2 or 3 mines. While there is some potential for limited open-cut mining, it is expected that these developments will principally be underground mines.

These resources represent the bulk of the Hunter Coalfield undeveloped coal resources. The strategic importance of these resources for the future of the New South Wales coal industry increases as options for new mine development diminish in other coalfields.

Previously it had been believed that the Gunnedah Basin would eventually replace the Hunter as the State's coal mining centre. However, the high costs of transport due to the distance of the area from the ports and the limited transport infrastructure, meant that it was essential that low cost open cut coal resources be identified. Recent exploration by the Department of Mineral Resources has shown that open cut coal resources in the Gunnedah Basin are very limited. Although substantial underground resources are known to exist, the current evidence suggests that many areas contain significant igneous intrusions that are likely to adversely affect the economics of underground mining in the area. In addition there is a potential for concern over the effects of subsidence on alluvial areas that are subject to flooding.

In summary, with dwindling options in the other coalfields for the development of new coal mines, it is essential that the remaining high quality coal resources in the Hunter Valley be available for mining. The perception by some members of the community that mining in the Hunter Valley is already too intensive will need to be addressed.

7.4 Southern Coalfield

Existing Mines

The Southern Coalfield contains the State's only known resources of hard coking coal.

In 1992-93 the Southern Coalfield produced 16.3 Mt. About 8.1 Mt was exported and about 8.2 Mt sold to steel mills.

The major domestic demand in this area is for 6-7 Mt of coking coal for Port Kembla, Newcastle and Whyalla Steelworks. Smaller amounts of low quality coal are supplied to the cement works at Berrima.

Project Areas

Existing projects in the Southern Coalfield are limited to Tahmoor North, in effect an extension of the existing Tahmoor mine, and Bargo, that has a shaft developed on a lease but shows no signs of being developed further. BHP holds extensive coal resources within long standing authorisations to the north of its existing mines. However, at this stage there is no definite time frame for the development of these coal resources. As discussed below, development of these areas is likely to face opposition from residents in existing urban areas, as well as competition from the urban expansion of south western Sydney.

Coal Development Areas

The region's hard coking coal resources are best developed in the Camden-Campbelltown-Picton area (figure 10). Although mining is considered deep by Australian standards (>400 metres) the price premium that these resources command means that mining at depths of 600 metres can be economic. To date mining has progressed from the south to the north exploiting ever deeper coal resources. However, proposed urban developments, particularly in the Macarthur South, Camden and South Creek Valley areas, flood-prone areas and the continuation of rural subdivision have the capacity to significantly affect coal resources in the short to medium term.

South-western Sydney has long been considered an area that can help accommodate Sydney's expanding population. The Department of Planning has carried out several studies on this area, the latest being finalised in 1991. This multi-disciplinary study concluded that several issues needed to be resolved before large scale development could proceed. In particular these relate to:

- water and air quality
- coal and methane gas extraction.

Preliminary Water Board studies into water quality and quantity have raised concerns about the impact of additional urban development on the Hawkesbury-Nepean River system. Until further water and air quality studies

are completed, there will be no decisions on major urban expansion in south-western Sydney. This also applies to the Camden/Narellan and South Creek Valley areas. Further work on the coal and methane gas resources is required for decisions to be made on the Macarthur South area.

Decisions on further urban development in south-western Sydney will be taken after the review of the Metropolitan Strategy has been completed. The Government has also indicated its objective of further increasing urban consolidation to slow the rate of urban sprawl.

The coal resources in the South Creek Valley amount to 400 Mt and in Macarthur South 600 Mt. It should be stressed that the Department of Planning fully acknowledges the importance of this resource. Its strategies are directed at minimising any loss of access to this resource because of urban development.

7.5 Western Coalfield

Existing Mines

In 1992-93 production from the Western Coalfield amounted to 12.0 Mt with about 2.4 Mt sold to power stations and 9.5 Mt exported. The Western Coalfield produces mainly steaming coal. Domestic demand for steaming coal for the Wallerawang and Mt Piper power stations will increase from 1.7 Mtpa to 5.5 Mtpa following the commissioning of Mt Piper in 1993. The largest contracts to supply Mt Piper have been awarded to Angus Place and Springvale Collieries.

Most of the existing mines are concentrated around Lithgow near the two power stations. However, several of these mines contain limited resources and may close over the next few years.

Project Areas

Project areas with sufficient coal of appropriate quality to support a new mining development in the Lithgow area are limited to Mt Airly and Running Stream. Further north Bylong may have some potential.

North of Mudgee the Ulan mine is planning extensions to its underground mine. However, these extensions are aimed at maintaining production at existing levels.

Coal Development Areas

Most of the available coal resources in the Western Coalfield have already been incorporated into National Parks.

The remaining coal resources that would be available for mining exist as isolated blocks or are confined to relatively small areas along the fringes of the National Parks. In this regard areas around Rylstone are considered to have the most potential.

Numerous proposals have been made to extend the Wollemi National Park, including one by the Colong Committee, the Colo Committee and the Federation of Bushwalking Clubs in 1985. This extension of 38 300 ha would join the Wollemi National Park to Pantoneys Crown and would include the Mt Airly/Genowlan mesas. Coal resources amounting to 970 Mt are located within this area that would cover several operating collieries. The National Park and Wildlife Service has advised the Department of Mineral Resources that there are no plans to revive the issue of the area being added to the Wollemi National Park.

A Private Member's Bill has been introduced by Dr P McDonald MP, which includes consideration of a comparable area to that proposed in 1985 in a National Park. It would similarly affect several operating collieries. For example, Baal Bone Colliery's life could be reduced from 15 - 20 years to two years because 40 Mt of mineable coal would not be accessible.

7.6 Summary

The Hunter region will be a major centre for new coal mine development over the next decade. Production from the Hunter Coalfield will therefore increase significantly as the many projects already in the planning stages commence production. Community concerns regarding the scale of these developments, particularly in areas around Muswellbrook, will need to be addressed.

In the other coalfields it is expected that, in the short term, new mine development and expansions of current operations will balance the loss of production from mines that cease to operate due to the exhaustion of economically mineable reserves. However, in the medium to long term, it is apparent that New South Wales has limited resources which would be suitable to sustain future new mine development. It is therefore important that the necessity of preserving these key resource areas be recognised.

8. COAL SEAM METHANE

Coal seam methane exploration is still at an early stage so that it is not possible to precisely forecast the effects of existing land uses or possible developments on methane gas exploration and exploitation if commercial discoveries are made. Therefore, no maps have been prepared which identify highly prospective areas as enclosure 1 does for coal resources. Nevertheless, some general comments can be made on the relationship between coal seam methane resources and other land uses that might affect its exploitation.

Bituminous coals typically contain gas consisting of over 95 per cent methane, with smaller quantities of carbon dioxide and higher hydrocarbons (although localised concentrations of carbon dioxide can vary over short distances).

Naturally occurring methane gas in coal seams has been a significant hazard to the coal mining industry throughout its history.

The majority of New South Wales coal mines mine coal at shallow depths where gas is of little or no consequence. However, in several regions, particularly in areas where mining is progressing into deeper coal resources, management of gas emissions is a significant economic and safety issue. Consequently, a number of mines have adopted in-seam drainage techniques to control gas emissions.

Gas from coal seams has recently been recognised as a potentially important economic resource. As a result, several companies are now undertaking greenfields exploration in New South Wales and Queensland with the aim of identifying economic gas resources within coal seams.

The recovery of coal seam methane using surface technology was first successfully trialled in the United States during the 1970s. Over the past 20 years a coal seam methane drainage industry has developed in the United States based on gas production from vertical wells drilled from the surface. Initially the development of surface production techniques occurred in collaboration with the coal mining industry. However, seam gas production by surface methods has now moved to exploiting greenfields gas resources. The industry now contributes about 10 per cent of the total US gas supply.

In New South Wales both Pacific Power and Amoco are actively assessing the coal seam methane potential of coal seams in the Southern, Newcastle, Hunter and Gunnedah Coalfields as well as the deeper part of the central Sydney Basin.

In fact very few areas in the Sydney or Gunnedah Basin have as yet been demonstrated to be unprospective for coal seam methane. This is a much larger area than that which would ever be prospective for coal.

Currently it is considered that some of the areas with the greatest potential for coal seam methane occur on the outer fringes of Sydney's urban areas, both to the north and south. Access to land for exploration and development is likely to be a key issue for the development of a methane drainage industry.

As an indication of the density of drilling required, to produce approximately 1 PJ of energy per annum from coal seam methane by surface drainage holes might require about 40 wells located on 13 square kilometres of land for periods of 5 to 20 years. In addition to the wells, significant surface infrastructure such as pipelines and compressors would be required to transport gas. Consequently, access to land is essential to the development of a surface-based coal seam methane drainage industry.

This land requirement is likely to result in two types of conflict:

i) Potential conflict with existing surface land use, in particular urban development.

ii) Priority disputes between coal producers and the developing methane drainage industry over access to coal.

The major difficulty in preserving access to areas thought to have coal seam methane potential is the lack of definition of the resource potential. Therefore, the demonstration of the feasibility of methane drainage in Australia and the identification of areas of high potential is considered the key to resolving conflict between competing land uses. Nevertheless, it must be stressed that only very limited land is required for extraction of the coal seam methane resource. If wells can be drilled and pipelines to carry the gas and the water produced with the gas to a central processing plant before urban development, the two land uses could be relatively easily made compatible.

When a coal seam methane resource has been defined, it is likely that community concerns over the risks, hazards and general intrusion of gas drainage systems into areas of residential development would need to be addressed in the planning stage of the project. Discussions with local councils and community education programs would help in reducing the impact. However, it should be stressed that risks are no more than for existing gas reticulation systems. A well location is equivalent to about a suburban residential block and can be readily screened by vegetation.

In New South Wales areas of interest for greenfields coal seam methane exploration and coal exploration areas overlap. This may result in conflict between the rights of coal miners and petroleum explorers for access to the coal resource.

In New South Wales petroleum exploration titles are generally excluded from colliery holdings by policy. However, exploration titles for coal and petroleum overlap. This situation could impede both coal seam methane exploration and coal resource assessment. Companies may be reluctant to commit to significant exploration expenditure unless there is a reasonable assurance that they would be allowed to proceed to a production or mining lease. Ideally, where exploration titles overlap, the coal title holder and the petroleum explorer should enter discussions at an early stage to resolve areas of uncertainty.

Coal mining and methane drainage need not be mutually exclusive. For example, with appropriate planning, coal production could take place in tandem with surface drainage by conducting drainage operations on parts of a coal lease for which mining is not planned for 10 to 20 years. Alternatively, in areas where multiple seams exist, surface drainage operations could target seams that are considered uneconomic to mine.

Co-operation between the two parties would be of mutual benefit. In particular by exchanging exploration data, the cost to each party of evaluating an area could be lowered. In addition surface drainage is likely to benefit subsequent mining by lowering gas emissions into the workings. Finally, information gathered in the assessment of gas and coal resources could assist in resolving planning issues related to surface land use.

9. STRATEGIES TO MINIMISE LAND USE CONFLICT

9.1 Introduction

The coal industry has made a long and vital contribution to the standard of living of the people of New South Wales by the revenue that it has generated, the associated employment opportunities, and its use in power generation and steel production. Clearly demand for New South Wales coal will remain at high levels for the next 30 years and beyond, as long as the industry can have access to the quality resources that exist.

However, this report has demonstrated that this access cannot be taken for granted. Already, urban development in the Newcastle Coalfield has severely constrained access to export-quality thermal coal. Restrictions on mining under urban development are seriously affecting the economics and coal resource base for future mining in the region.

A similar conflict is occurring in the Southern Coalfield where mining is facing opposition at Picton as it progresses towards more urbanised areas. In addition the major growth centres of Camden and Campbelltown have the potential to constrain access to the State's only remaining unallocated resource of hard coking coal.

In the Western Coalfield 75% of the coal resources have been incorporated into National Parks, leaving only a few isolated areas around the fringes cf the National Parks available for development.

In the Hunter region, several major coal projects are in various stages of development, including Dartbrook, Bengalla and Mount Pleasant. These projects represent the bulk of the region's undeveloped coal resources. West and north of these developments coal resources (principally underground) exist, but are limited in extent.

The high cost of transport from the Gunnedah region and the limited transport infrastructure constrains development in the Gunnedah Basin to low cost (i.e. open-cut) coal resources. However, recent exploration by the Department of Mineral Resources has shown that open-cut coal resources in the Gunnedah Basin are very limited. Substantial underground coal resources are known to exist, but current evidence suggests that many areas contain significant igneous intrusions. These are likely to adversely affect the economics of underground mining in the area.

The dwindling options for coal development in each coalfield due to the loss of coal resources to competing land uses threaten the long-term future of the coal industry.

There are enough projects at an advanced stage to meet projected demand for the short term. Medium term demand can be met if access to several prospects can be assured against competing land use pressures. However, access to resources defined as having high potential in figures 7-11 is required to ensure the future growth of the industry beyond the next 15-20 years. The Working Party acknowledges the difficulties posed by the requirement to preserve access to these poorly defined resources for such a long time, particularly when there are other, more immediate land use pressures.

9.2 General Strategies

This study aims to lead to the achievement of a reasonable balance between coal mining and other land uses through a strategic coal development plan that addresses issues related to coal resources in four categories:-

- Resources within existing mines
- Resources within project areas
- Strategic coal resource areas
- Other coal resources

Strategies addressing these resource categories can be divided into a number of broad headings

- Protection of strategically significant coal resources.
- Implementation of multiple and sequential land use concepts
- Assessment of the impact of alternative land uses on coal resources
- Increased liaison and information exchange between the coal industry and the community

Protection of Strategically Significant Coal Resources

Sensible land use planning cannot occur unless the coal resources have been properly assessed. The Department of Mineral Resources should continue to

assess the coal resources in areas subject to land use planning pressures so that decisions can be based on an appropriate assessment of the significance of the resources present.

The main aim would be to highlight key coal resource areas vital to the future of the New South Wales coal industry in each coalfield. Ideally, once identified, the resources should be given some level of protection, possibly through a planning classification that would exclude land uses that would be incompatible with future mining. These zones should form ideal models for the concepts of multiple and sequential land uses.

Areas that should be considered for some form of protection are shown in enclosure 1.
Such a classification would have several advantages:

- The local community would benefit by having the key resource areas clearly identified. Medium to long term planning could then take into account these future coal developments.

- The coal industry should obtain greater security over the resources needed to meet future coal requirements.

- The process of obtaining approvals for mining developments in these areas should be facilitated, due to the previous identification and forward planning that has taken place.

Multiple/Sequential Land Use

Sometimes, land has been seen as being capable of a single use only e.g. open cut mining or agriculture. However, it is often possible for an area to have more than one land use, which may be multiple and/or sequential. Multiple land use means that more than one land use may be carried on in a designated area e.g. mining under active farming land. Sequential land use refers to changing land use over time, e.g. from agriculture to mining or mining to recreation. Multiple and sequential land use involves optimising the use of the land, compared with an approach that determines what single purpose the land might best be used for. Although the planning system does allow for this concept, the reality is that the community does not always accept the principle of sequential or multiple land use.

South Australia, Western Australia, Northern Territory and Queensland have adopted these concepts as a policy for the achievement of sustainable development. South Australia and Queensland have made specific legislative provision to allow exploration and mining to coexist with conservation in

"regional" or "resource" reserves. However, New South Wales would need to develop its own model to suit its land management systems, rather than copy another state's system.

Resource Impact Statements For Conservation Areas

A formal process needs to be developed for addressing land use conflicts over conservation areas. A key aspect of this is that proposed conservation areas in the coalfields need to be subject to a formal resource assessment process. It is envisaged that such a process could be similar to the process used for Environmental Impact Statements. The aim of a **"Resource Impact Statement"** would be to ensure that all resources are valued and given proper consideration so as to assess whether or not conservation dedication is an appropriate land use for the area.

Sensible land use planning cannot occur unless the coal and petroleum and mineral resources are properly assessed; the Department of Mineral Resources is the appropriate body to carry out this task.

Liaison

Increased consultation between proponents of different land uses will reduce ignorance and misunderstanding of each side's position and hopefully lead to solutions that take into account each side's concerns.

Occasionally fundamental policy differences will mean that disputes cannot be resolved by discussions between the parties. Conflict resolution mechanisms are therefore required to deal with such cases. An example is the Natural Resources Audit Council that has been established by the Government. This Council comprises representatives of the relevant agencies who will make the necessary assessment and provide recommendations to the Government where there are competing land uses.

9.3 Strategies for Specific Land Uses

Besides the broad strategies outlined above several strategies have been developed to address specific land uses that have a major affect on coal resources. These strategies are outlined below.

Conservation Areas

Issues:

Proposals for new conservation areas and access to existing conservation areas give rise to separate issues. There has been a lack of information exchange in the early stages of forward planning of new conservation areas between the National Parks and Wildlife Service and the Department of Mineral Resources.Multiple land use involving mining and conservation has to be considered, in contrast to a widespread belief that the two are incompatible in all circumstances.

In the past, processing of some proposals for National Parks and other conservation areas has been subject to outside pressures, which has not allowed a complete analysis of conservation values or a consideration of other resources contained in the areas. The Department of Mineral Resources developed the "Planning Focus" mechanism to deal with Government organisations' responses to proposals for new coal leases, and acts as coordinator of the "Planning Focus" meetings. These meetings provide the mining company concerned with an opportunity to brief the relevant government authorities on its proposals and to identify all pertinent issues at an early stage.

If the National Parks and Wildlife Service were to organise similar meetings and specify the particular habitats, scenery or other features to be preserved, this would give the opportunity for all the resources of the area to be assessed. The appropriate conservation category and area could then be determined after this consultation. The National Parks and Wildlife Service could then prepare draft conditions before dedication of an area. These plans would take into account land uses that might be appropriate and compatible.

A difficulty in the present system of conservation areas is that there is no category in which multiple land use is widely accepted as being compatible with preservation of conservation features. A Legislation Committee on the National Parks and Wildlife (State Conservation Parks) Amendment Bill 1992 stated "the proposal for State conservation parks should, if implemented, be based on a multiple land use conservation category that includes provision for current and future exploration and mining". Part of the difficulty in such

multiple land use is the public perception that multiple land use and preservation of conservation values are mutually exclusive.

The Working Party recognises that even if there is improved consultation and information exchange, there will still be situations where decisions must be made between mining and conservation areas. Information gathered by the Natural Resources Audit Council referred to above might be able to assist in minimising some of these land use conflicts.

The NSW Coal Association and the Australian Coal Industry Council carried out a survey that dealt with community attitudes to the coal industry. It found that there was community support for the concept that development can be compatible with nature conservation.

Protection of ecosystems that might be affected by coal mining developments should also be considered. This issue would be addressed during consideration of the EIS by the designated authority and conditions imposed at that time. After mining commenced, if the Department of Mineral Resources had concerns that the measures proposed to protect ecosystems were inadequate, it would require the proponent to obtain independent advice that the ecosystems would not be damaged by the predicted subsidence.

Strategies:

- **Before an area is declared a conservation area a formal process needs to be followed which provides for a full assessment of all resources in the area. This will in effect be a Resource Impact Statement for the conservation area.**

- **Development of a multiple land use tenure classification for conservation areas is considered essential.**

Urban Development

Issue:

Both the coal mining industry and urban development will require access to significant areas of additional land in the Newcastle and Southern Coalfields in the future.

The competing land uses in these coalfields require a continuation of the high degree of ongoing liaison between the Department of Mineral Resources, Department of Planning, Mine Subsidence Board and the local councils in

these regions. The Macarthur South Regional Environmental Study and the Camden Flood Plain Study are examples of this cooperation.

When the coal resources of the coalfields have been accurately mapped, two objectives will have been achieved - areas without potential will have been identified and will be available for urban or other development and areas with high grade coal to which access should be ensured will also have been identified.

Increased extraction of coal, with positive effects on the economics of mining, can be achieved if houses with greater resistance to subsidence are built. In this respect continued research into building design should ultimately translate into higher levels of coal extraction in some areas provided the community is prepared to adopt the advances achieved in building design and accept that some subsidence is a necessary concomitant of underground mining.

Strategies:

- **The well established liaison between the coal industry, Department of Mineral Resources, Department of Planning and local councils should be maintained and improved to minimise coal resource wastage.**

- **A special zoning classification needs to be developed to cover areas known to contain high quality coal resources of strategic importance to the future of the coal industry. Land uses incompatible with coal mining would be restricted.**

Infrastructure

Issue:

> ***Surface infrastructure may result in restriction of mining due to a reluctance by the authorities concerned to allow mining beneath infrastructure because of concerns regarding safety or damage to critical structures.***

Considerable progress has been made in easing longstanding restrictions imposed on mining under various types of infrastructure. The restrictions have been eased because of a better understanding of subsidence issues.

Longwall mining under the Great Northern Railway is an example where research was successful in demonstrating that mining could safely take place

under key infrastructure. Similarly, engineering solutions have been devised in the design of transmission towers to allow for the effects of subsidence.

Surface subsidence predictions have advanced considerably since the guidelines for mining under stored bodies of water were framed in the 1970s, as has an understanding of subsurface strata behaviour in mines. South Bulli Colliery in the Southern Coalfield carried out a thorough research program before applying to mine under the Cataract Dam storage area; its application was then approved by the relevant authorities after they were satisfied that there was no risk to the dam storage involved.

Research should be considered and carried out where appropriate, on a case by case basis, to reduce the quantity of coal that must be left to protect the infrastructure.

Although overseas experience and research into subsidence have enabled the lifting of many restrictions, clearly the best solution is to avoid siting infrastructure over economic coal resources. The identification of coal resources will help in positioning infrastructure in the optimum location.

Strategy:

- **Identification of the extent of coal resources will allow the optimum siting of roads, pipelines and other infrastructure to minimise the impact on coal extraction.**

- **Continued action to demonstrate that coal mining can safely take place beneath infrastructure.**

Prime Agricultural Land

Issue:

> ***The power of veto by the landowner to exclude open cut mining from Agricultural Land.***

The mining of Agricultural Land has been opposed by the farming community because of:

- doubts that the land can be satisfactorily restored to previous levels of productivity

- concerns over the possibility of flooding

- concerns over the effect of mining on water quality.

Most of the State's remaining open-cut coal resources in the Hunter and Gunnedah Coalfields are potentially affected by Agricultural Land. Overseas experience has suggested that many concerns expressed regarding mining of Agricultural Land can be addressed. Technical and engineering solutions are available to restore mined Agricultural Land to its pre-mining productive capacity.

Many of the environmental issues related to mining of Agricultural Land should be addressed through the normal EIS process. It is difficult to identify strong reasons why Agricultural Land should be in the privileged position of having the potential to trigger a veto whereas other potential environmental issues do not and are addressed through the normal EIS process.

Strategy:

- **Demonstration through research projects of the industry's ability to restore Agricultural Land.**

- **Dissemination of overseas experience and the results of local research into restoring Agricultural Land.**

- **Pursue issues concerning the mining of river flats through the normal EIS process, which would provide adequate protection.**

Natural Features

Issue:

> ***Mining under natural features may need to be limited because of the potential for damage if the underlying coal is fully extracted. Mining may also have to be limited under flood-prone land or foreshores to prevent damage to natural features or surface structures.***

The Department of Mineral Resources limits mining of coal under natural features. It has issued clear guidelines for mining under foreshores, so that subsidence will not exceed limits above which damage might occur. Damage that has occurred in the Lake Macquarie area relates to mining predating the current guidelines. In areas where the cause of subsidence in old mines is not known, mining is prohibited. The guidelines were set after consultation with the mining industry and local councils. A similar procedure will be followed in establishing guidelines for mining under flood-prone areas.

The Department of Mineral Resources has placed increasingly tight restrictions on mining under significant escarpments to prevent major cliff falls, as for the Airly Mountain project. The Department has an ongoing research program into the effects of mining on escarpments.

Ongoing Action:

- **Rigorous assessment of plans to mine under natural features should continue to be carried out by the Department to minimise damage to the features.**

- **Guidelines for mining under natural features should be monitored and updated as required in the future to ensure that there is appropriate protection for the features as well as economic coal extraction.**

Commonwealth Land

Issue:

Two areas of Commonwealth land, at Holsworthy and Singleton, are currently excluded from mining; both cover substantial coal resources.

Strategy:

- **Discussions should be held with the Commonwealth Government by the NSW Department of Mineral Resources to determine if there is a possibility of the resources being exploited in the future.**

Coal Seam Methane

Issue:

Two types of conflict could occur in the exploitation of coal seam methane resources:

- ***Potential conflict with existing surface land use, in particular urban development;***

- ***Co-ordination between coal producers and coal seam methane producers over access to the coal.***

Ongoing Action:

- **Coal seam methane explorers should be encouraged, as a matter of urgency, to test areas where urban development is likely to proceed so that access to the resource can be incorporated into planning objectives.**

- **Close liaison is necessary between the explorers, the Department of Mineral Resources and planning authorities to enable potential conflicts to be resolved at an early stage.**

- **Where coal and petroleum titles overlap, the title holders should enter discussions at an early stage to resolve areas of uncertainty, with the Department of Mineral Resources facilitating the process if necessary.**